The Welding Engineer

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A Modern Method of Research

THE value of your business paper to you as an individual is only a detail in the complete story of the value of business papers to industry. Many men who have come to rely upon business papers as a splendid source of industrial information may be surprised to know that they are not enjoying any secret. A very interesting article in a recent issue of Sales Management by Carolyn F. Ulrich, Chief of the Periodical Department of the New York Public Library, states that today about two-thirds of the people coming to that department of the library are there for a serious purpose and that business men are coming increasingly to consult the trade publications in the library. The great majority of them are after information on particular topics and are not at all backward about asking for information about their own business. The reason given for this is that business today moves so fast that no man can pretend to a complete knowledge of his field unless he makes a practice of studying constantly the news of changing conditions as it is recorded for him in his trade and business papers. It is stated that there has developed a steady demand for material concerning the problems of design and redesign of merchandise. It is also advanced that the increased reliance on industrial and business publications by business men is in no small measure a reflection on the increased merit of the publications themselves. In other words, you are not old-fashioned so long as you keep up with your business paper, but you begin to fall behind the times as soon as you start leaving it unopened in its wrapper.

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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EDITORIAL

Doing Something About Unemployment

IT IS the opinion of the President's Emergency Committee for Unemployment that action toward the further stabilization of employment would be effective in bringing about a better functioning of American business as a whole. This committee has the cooperation of more than a hundred trade associations, and the reports received from these associations are constantly yielding additional information which may be applied directly to the present condition and also to the building up of a more permanent program of employment. No executive who takes the trouble to follow the work of this group can fail to recognize that something definite is being done. In this connection it must be recognized that there are not only local, but also international, economic conditions which have gradually developed the present picture. The development has been a long time coming, and the picture cannot be changed overnight. It is encouraging, however, to find that many industrial leaders have put some real thought on the problem and worked out a series of solutions adaptable to many typical conditions. The President's Committee has issued some very helpful literature. One pamphlet gives a composite picture of the methods which are being applied by many industrial firms to spread employment in times of business depression. Another pamphlet gives the text of a series of radio addresses given under the auspices of the committee, and a third pamphlet gives a selected bibliography of industrial plans for regulating employment. These are all sources of information on a vital industrial problem which are to be had for the asking. They represent the attempt of America's greatest industries to handle the employment problem by pooling all available information. This tangible evidence of the activity of such an important emergency committee should receive the careful attention of every responsible executive. The fact that something is being done in the emergency may encourage action on the part of some who have been content to fire all the help they did not need and hope for business to get better.

Welding Special Metals

SINCE nearly three-fourths of the welding done at present is on parent metal of mild steel, this metal has naturally been chosen as the starting point in the development of standards of procedure, training and inspection. What the man responsible for results needs to remember is that when other metals are to be welded he must expect to change some, if not all, of these standards to fit the requirements of the different materials. The welding of the corrosion resisting alloy steels is an excellent example. In this case an expensive metal is used to accomplish a definite purpose, and failure means big loss in material as well as labor. It is therefore necessary to produce a welded structure which is not only strong enough for the job but also which possesses the property of resisting corrosion in the same order as the parent metal, a factor which is not generally considered in the conventional tests for ordinary steel welds. This can be done if the procedure is prepared with this purpose in view. The same is true of many other commercial metals which are being welded. The secret of success lies in knowing what is wanted of the welded job and making plans to get that kind of result.

To Eliminate Waste in Heating Boilers

A SUMMARY report of a survey of the various low pressure steel heating boilers recently conducted by the Division of Simplified Practice of the National Bureau of Standards has been mailed to those interested according to a recently published announcement. Twenty-one firms, representing over 90% of the 1930 output, reported total shipments of nearly 8,000 boilers, 75% of which were of the welded combination type. Over 3,000 were to be mechanically fired. Eighteen different kinds of boilers were reported, each of them made in from 6 to 132 different capacity ratings. The total variety aggregated 1,072. An analysis of the two most popular kinds of boilers showed that over 80% of the sales were made in 20% of the capacity produced and that no shipments were made in over 20% of the capacity manufactured. A detailed report of this survey is in the hands of the Simplified Practice Committee of the industry and is being used as a basis for the development of the simplified practice recommendation, on the capacity of low pressure steel heating boilers in an attempt to eliminate the waste prevalent in this field. Such well directed and organized effort to reduce production costs deserves special consideration from industries in this particular field. The figures quoted above from the survey show very clearly that costs can be reduced in ways that are more logical than the method of using the cheapest materials and the cheapest labor. It is certain that the firms who realize the value of producing quality products will take advantage of the savings which undoubtedly will be indicated before the work of the Simplified Committee has been completed.

The Inspector and His Job

WRITERS and speakers are careful these days to make sharp distinctions between testing and inspecting. This is because the inspector is becoming an increasingly important figure in the welding picture. His work is more carefully planned for him than ever before, and the whole industry is taking an interest in developing new methods for him to perform his function. His real job is not to locate and discard pieces of poor workmanship, but rather to control the quality of all the workmanship which comes under his jurisdiction. The directors of the Office Centrale in Paris have had this point of view for many years, and in many of their publications they use the word "control" in places where our own practice would be to use the word "inspection." However, it seems proper to recognize other factors in the makeup of a complete control over any welding operation, and not place all of the burden of responsibility for weld quality on the inspector. The important thing is to guard against considering him as a possible wet blanket, and think of him as being there to get the job done as it should be done.

Training for Supervisors

OBSERVATION of the things which interest the men who attend the welding conferences points to a need for advanced courses of training for welding supervisors and foremen. Such courses would provide instruction in training, testing, organizing operations, selection of materials, checking designs, evaluation of welds, cost keeping, and similar subjects which affect the economy and efficiency of the welding program. The tendency has always been to pick out the best man available and put him in charge of the job. Why not give him a special training course to round out his capacity and make him still better?

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Inspection Safeguards Quality*

Preliminary Inspection Must Include Observation of Operator's Technique in Order to Be Complete—Periodic Tests Maintain Quality

By R. Kraus†

THE question, "Can the quality of a finished weld be determined from its external appearance," is frequently asked by those who become interested in the application of welding. An answer in the affirmative can be given. A good and a bad weld have their definite characteristics, easily recognized by average inspectors and supervisors, with no elaborate methods or rules necessary.

Inspection in Progress

A weld is intended to be a suitable bond between two component parts of a structure. To accomplish that purpose, fusion of the weld with the parent material is necessary. To make sure of it is the most important function of the welding inspector. He has to follow the technique of the operators by watching at intervals the welding in process through a

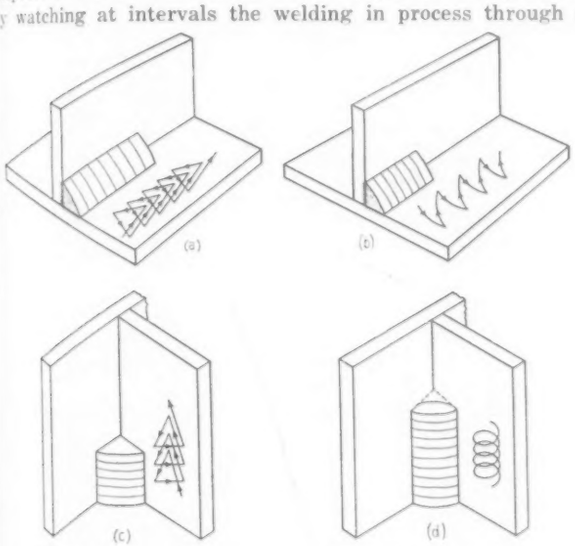


Figure 1. Correct and Incorrect Methods of Weaving.
(a) Triangular Motion Requires Hesitation at Each Corner of Triangle. (b) Semi-Circular Motion Requires Slight Hesitation at Each End of Stroke. (c) Triangular Path for Vertical Welds Requires Somewhat Faster Movement Across Hypotenuse. (d) Oval Motion Misses Fusion in Corners.

hand shield. He must be certain of sufficient penetration and fusion along both sides of the fillet as well as at the root of it. The same applies to the sides of butt welds or any space intended for a weld.

Methods of Weaving. Various ways of guiding the electrodes along the intended path of the weld are in practice, requiring different degrees of skill. The inspector is satisfied with any of them as long as the common purpose is met; namely, fusion. The technique of semi-circular motion, shown in Figure 1b, is well known. The operator must stop for an appreciable moment at each end of the stroke in order to assure penetration. Another method, shown in Figure 1a, is a triangular path, which lends itself particularly to getting fusion in the corner and on the sides. The operator must also hesitate for a moment at each corner of the triangle. This triangular path is well adapted for vertical welds. For good fusion, a slow motion along the sides with a pause at the corners is followed by a faster one along the hypotenuse to prevent the hot metal from rolling over, Figure 1c. For proper results with the semi-circular path as well as with the triangular motion it is absolutely essential that the operator stops at each end of the stroke. If he does not and changes the first method to the sweeping motion of a paint brush and cuts corners for the second, modifying the triangle to an oval (Figure 1d) poor fusion will result. In order to be sure of good fusion, by an operator of medium skill, the Westinghouse Company adopted a method of laying beads parallel with the length of the weld, followed with cover beads

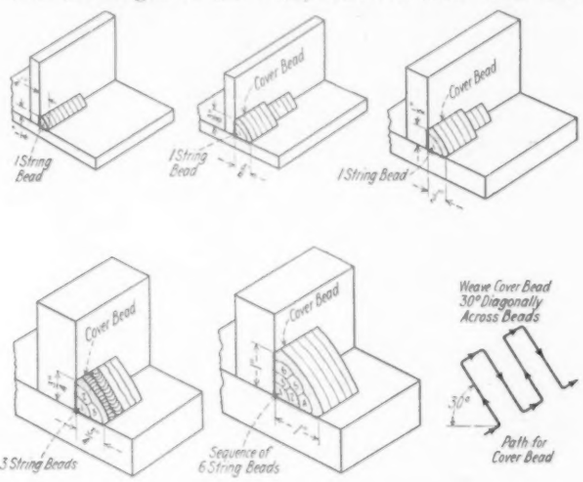


Figure 2. Welding Methods Used.

for ⅜-in. fillets and larger. The beads are laid with practically no weaving, consequently, the operator does not have the problem of remembering to hesitate for penetration. With the cover bead, the operator works again almost mechanically; he turns along the fillet at an angle, turns the corner at the fillet edge and, thereby, obtains positive penetration. Figure 2 illustrates the method for ¼-in., ⅜-in., ½-in., ¾-in. and 1-in. fillets. The path of the cover head is indicated separately.

Length of Arc and Position of Electrode. The inspector must see that a short arc is maintained consistently by the welders. The length of the arc should about equal the diameter of the rod used. A short arc prevents the absorption of oxygen and nitrogen by the hot metal, the first

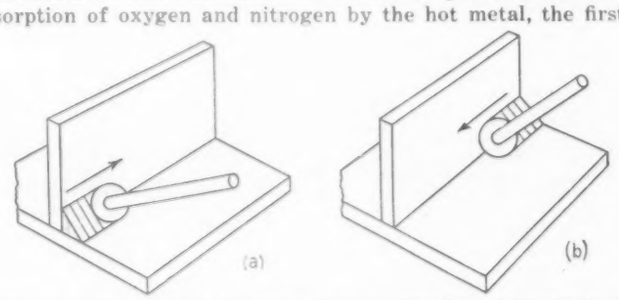


Figure 3. Correct and Incorrect Relative Position of Electrode to Molten Metal.
(a) Correct Method. Rod Should Be Vertical to Face of Pool. (b) Incorrect Method. Rod Parallel to Face of Pool.

one creating oxides, while the second one causes brittleness of the iron. Another essential feature of the short arc is better penetration, because of the small surface heated. With a long arc, too large an area is covered by the unsteady arc to secure penetration.

The operator, also, has to hold the electrode correctly,

*Paper presented before Pittsburgh, Pa., Convention of the American Society for Testing Materials, March 16-20, 1931.

†Supervisor of Welding Inspection, Westinghouse Electric and Manufacturing Co.

namely, vertical to the pool and not at the wrong angle. In extremely bad cases, the operator may even hold it parallel with the pool, just melting the rod and running the hot metal ahead of him without penetrating into the parent material.

In the language of the shop, it is correct to pull the weld,

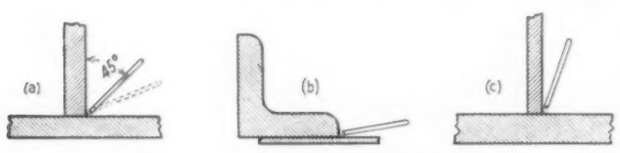


Figure 4. Correct Angle of Welding Rod for Uneven Thickness. (a) Position of Electrode for Material of Approximately the Same Thickness. Incorrect Position is Shown Dotted. (b) Welding a ⅛-in. Sheet to a Heavy Angle. (c) Position of Electrode for Materials of Unequal Thickness.

but not to push it. Figure 3 shows the two methods, the correct one at the left, and the wrong one at the right.

When pieces of different thickness are being welded together, it is necessary to play the arc sufficiently on the heavier section, otherwise, fusion will be missing there; the greater thermal capacity delays the material from reaching the fusion temperature. Figure 4 illustrates the method for materials of different thickness; also of welding sheet steel to heavy angles and, for comparison, the position of the electrode is also shown for plates of the same thickness.

An indication of the penetration can also be seen on the vertical side walls. An undercut is frequently evident along the edge of the fillet. In a vertical weld as shown in Figure 5, this undercut is visible in both walls. In a horizontal weld, the molten filler material covers the undercut or the dividing line between the molten parent material and the portion that remained solid. The undercut referred to must be slight and should appear more like a shadow line. A deep undercut in both walls indicates that an excessive current has been used for the size of the electrode. Lack of fusion will show up in extremely bad cases as soon as the material cools. The contraction of the weld metal will cause the base of the filler to pull away from its seat on the parent metal to which it was not fused. This con-

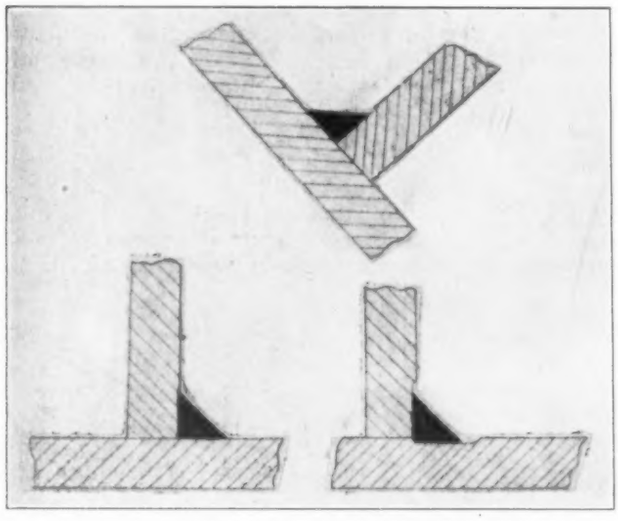


Figure 5. Undercut in Side Walls. (Above) Undercut on Both Ends of Fillet Occurring When Fillet is Located as Shown. (Below) Left: Undercut in Vertical Wall Only. Right: Undercut in Both Ends of Fillet Due to Excessive Current for Size of Electrode.

dition is more likely to occur in corners which are subject to magnetic blow. The defect can be noticed by the accumulation of iron particles along a clearly defined line due to the magnetism created in the steel during the welding. If the evidence is obliterated by brushing or shot blasting, it can be easily reconstructed by blowing iron dust against the suspected area. The same method can be applied to make sure of a crack. The two sides of a fissure are of different polarity and will, therefore, attract iron particles. Cracks may be visible to the naked eye or may be verified by means of a good magnifying glass.

When it is doubtful if one is looking at a hair crack or just a fine ripple in the surface of the fillet, drill a ½-in. hole in the weld, as shown in Figure 6. A clear line inside of the hole will indicate a crack.

If the materials have fused partially and a slight overlap makes it difficult to judge penetration, then it becomes necessary to remove a section of the weld to make sure of fusion. It can be done quickly by burning out part of the weld. First, cut through the weld, as shown in Figure 7; then melt the material away, beginning at the outer part (see arrow B). The last layer will curl up like a sliver. The heat will not be transferred through a layer of trapped slag to the piece where fusion is missing; the black appearance of the parent metal will be exposed. If a man, experienced in handling a torch, is not available, a section of the doubtful weld can be chipped out. To

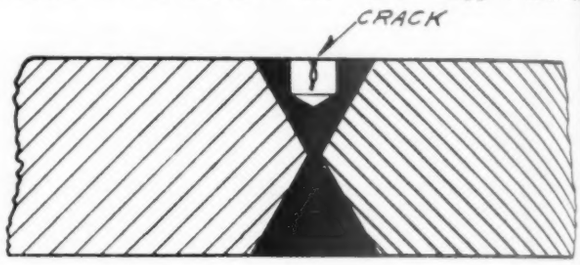


Figure 6. (Above) Doubtful Cracks in the Weld May Be Checked by Drilling a ½-in. Hole.

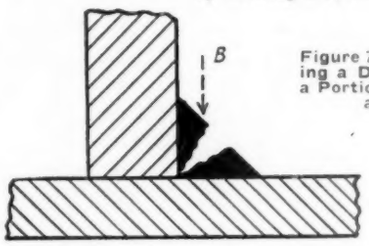


Figure 7. Another Method of Checking a Doubtful Weld Is to Cut Out a Portion to Disclose Black Appearance of Parent Metal.

prevent destroying the evidence by either peening over the crack or by driving the filler in the parent material, it is necessary to cut through the weld and separate a section, as shown in Figure 8. If it can be lifted out to disclose the black appearance of the parent metal, as explained previously, the materials have not fused together.

Checking of Polarity. Work requiring reverse polarity will alternate with jobs that can be welded only with straight polarity, that is, the positive side of the line connected to the work. The polarity can be checked readily with a graphite electrode as shown in Figure 9. For straight polarity, the carbon end becomes blunt and the arc, in the shape of a pronounced cone, seems to start from the carbon; with reverse polarity, a crater is formed in the carbon and the arc appears to start from the work and is harder to maintain. Welders familiar with one make of wire will notice the increased melting rate of the metal electrode. A crater in the work will only be possible for straight polarity with either electrode.

Gauges. The operators and the inspectors are provided with fillet welding gauges; the throat of the weld, Figure 10a, is the weakest section of the weld. It can readily be checked by means of a gauge. Its flat portion makes contact with the hypotenuse of the fillet, while the two right angle sides rest on the component parts. The corners of the flat are relieved, which permits the use of the gauge though the weld might deviate slightly from its ideal form. In the average run of the work, the gauge will not always

touch both right angle sides, because the welds are sometimes oversize, as indicated by Figure 10c, while Figure 10d represents an undersize weld; the flat of the gauge does not butt at all on the weld. On this continent, the size of a fillet weld is designated by the length of fusion with the parts joined. Again referring to Figure 10b, the two lines in each corner, intersecting at right angles, point to the fused section, given on the drawings as the size of the weld. An excessive difference, particularly along the horizontal surface is not permissible, because frequently there is less fusion there than on the vertical wall. However, it is acceptable as long as the actual fused section is not

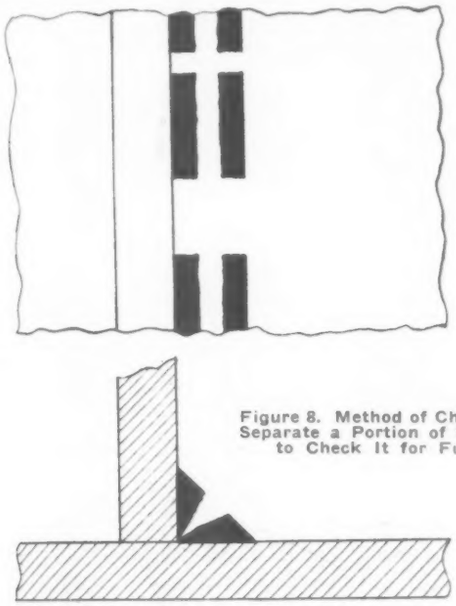


Figure 8. Method of Chipping to Separate a Portion of the Weld to Check It for Fusion.

less than the throat section. The American Bureau of Welding recommended the method of gauging described. The Westinghouse Electric and Manufacturing Company, at East Pittsburgh, developed the gauge in the form shown in Figure 10b. Each of the four corners is utilized. A set of the two gauges will cover most of the requirements; one gauge takes in the ¼-in., $\frac{5}{16}$-in., ⅜-in. and ½-in. fillets, and the other is arranged for ⅜-in, ½-in., ¾-in. and 1-in. fillets. With the help of the welding gauge, it can be quickly decided about the size of the various fillets shown in Figure 11. The first fillet is of correct shape; comparing its throat section with those of the other fillets, makes their undersize evident.

Testing Welders

Quality of welds depends on the conformity to the drawing, in size and location and to a great extent of fusion of the filler with the parent metal. This is so important that it was found advantageous to test the welders periodically for their ability to deliver the quality desired. These tests are carried on monthly in the Westinghouse Electric & Manufacturing Co. under the supervision of a staff member of the Manufacturing Equipment Department.

The test pieces were devised to check fusion and at the same time permit a measurement of the quality of the weld in pounds per square inch. Several specimens, made up of different thicknesses of material are used. One of these test pieces is shown in Figure 12. The thickness of the upper and lower strap is automatically a gauge of the size of fillets. Four fillets are confined in a small space; the fusion of each one effects the test; the welds are not machined and are, therefore, more comparable to actual shop condition. This is, in addition, an economical advantage, which expedites the test of and lowers its cost.

A minimum of 40,000 pounds per square inch is required from shop welders, while operators for welding buildings must pass a minimum test of 45,000 pounds per square inch.

Signing of Work by Welders. With a large number of welders working in the shop in successive shifts and, frequently one group continuing the work of the preceding group, it is essential to be able to identify the work of each

Figure 9. Polarity May Be Checked as Shown by Means of a Graphite Electrode.

welder and make him responsible for it. This is accomplished by assigning each welder a stencil. The welder places his stencil near each weld or at the start and finish of a group of welds.

Qualifications and Selection of Inspectors. Welding inspectors are promoted from the ranks of welders, chosen for their experience and also for the proved reputation of being reliable; they must read blue prints readily, be able to deal with men and have demonstrated their qualifications as mechanics.

In the shop, where the operators are close together and the inspector is familiar with the traits of the welders, he can inspect the work of approximately twenty-five men. It is understood that the inspector needs to watch the operators at intervals only, as good welding becomes a habit to some extent. In building work, about twelve operators is the limit for one inspector; the men are generally scattered on two or three floors and most of them are new to the inspector.

Non-destructive Tests

For vessels, like tanks for circuit breakers, regulators and transformers, additional tests are necessary after completion of the welding in order to determine if the welds are oil tight. For mercury-arc rectifiers, part of the welds must be vacuum tight and others water tight. A variety of non-destructive tests were adapted to the application or the equipment available for test.

Water Gravity Test. The water gravity test is used occasionally. It does not require much equipment, but is not recommended highly. The water has the tendency to induce

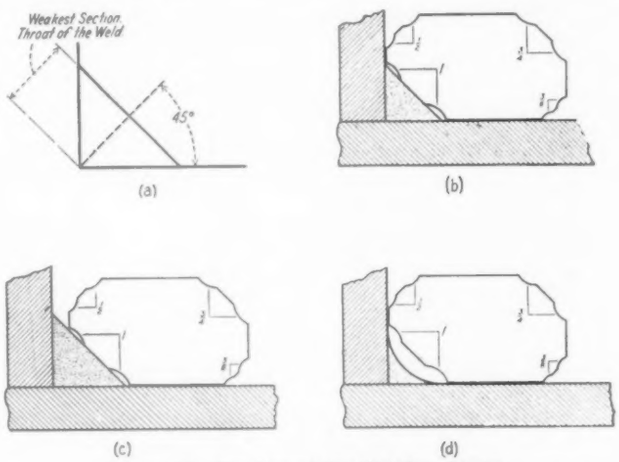


Figure 10. The Use of the Welding Gauge.
(a) Location of Weakest Section of Weld. (b) Weld of Correct Size. (c) Oversize Weld. (d) Weld Too Small.

rust quickly, which closes fine leaks temporarily. With tests of this type, it is advisable to create vibrations in the vessel by means of hammer blows. Weak spots in welds will frequently break by shocks. It is far better to locate them that way, than to wait until stresses, from handling of the

completed apparatus or during shipment, will show up the defects.

Kerosene Tests. Vessels that cannot be conveniently closed for the soap and bubble test, which is described later, can be reliably tested with kerosene; its penetrating qualities will show up the most minute leaks on whiting painted over

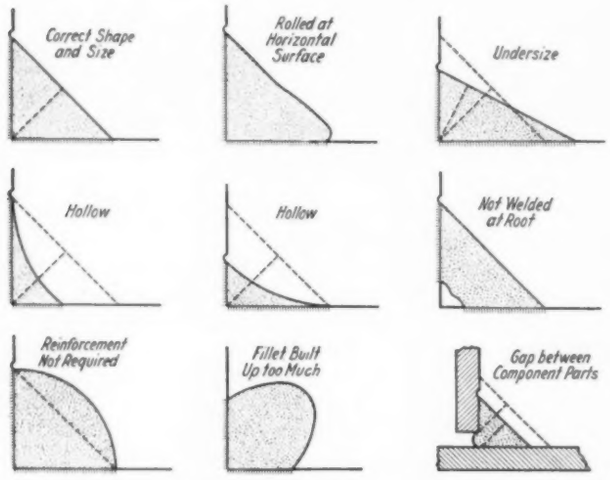


Figure 11. Various Imperfections Compared with a Perfect Weld.

the welds. The draw back of this test is that leaks can only be repaired after the vessel had been emptied and the kerosene burned out of the defective spots.

For testing of large quantities of tanks, it is essential to reduce the manual handling. Methods must be adopted that will prove the tank suitable for its purpose at a minimum expense.

Air Test by Immersion. The simplest test is by means of immersion. It can be applied to tanks that do not have to withstand high operating stresses and are made of relatively heavy material. Figure 13 shows such a tank in the test rig in the process of being immersed in the large tank filled with water. The tank to be tested is placed on a shelf, (not visible in the picture as the tank is partly immersed) connected by means of uprights and cross bars to a chain hoist. A suitable cover, with packing, is pressed quickly against the tank by means of an air cylinder mounted on the cross bars. The tank is connected to the air pressure line. Any defects in the welds show up by the air bubbles in the water.

High Pressure Tests. Circuit breaker tanks that have to be, not only air tight, but must withstand high stresses occurring inside a tank during an explosion accompanying a

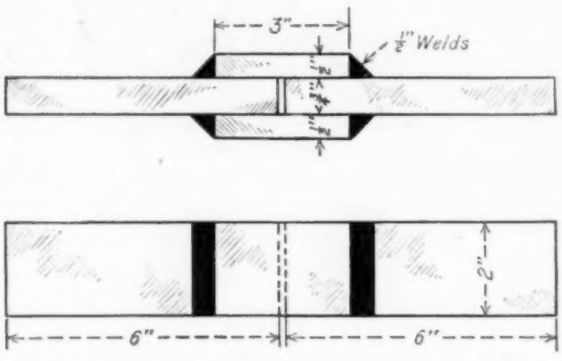


Figure 12. Test Specimen for Welders.
Material: 2 Pieces, ¾x2x6 in., Bar Stock, Hot-Rolled Steel; 2 Pieces, ½x2x3 in., Bar Stock, Hot-Rolled Steel. Weld with Two Layers Using ⅛-in. Welding Wire. Minimum Load, 40,000 Lbs. per sq. in. Minimum Load per Test Specimen, 50,000 lbs.

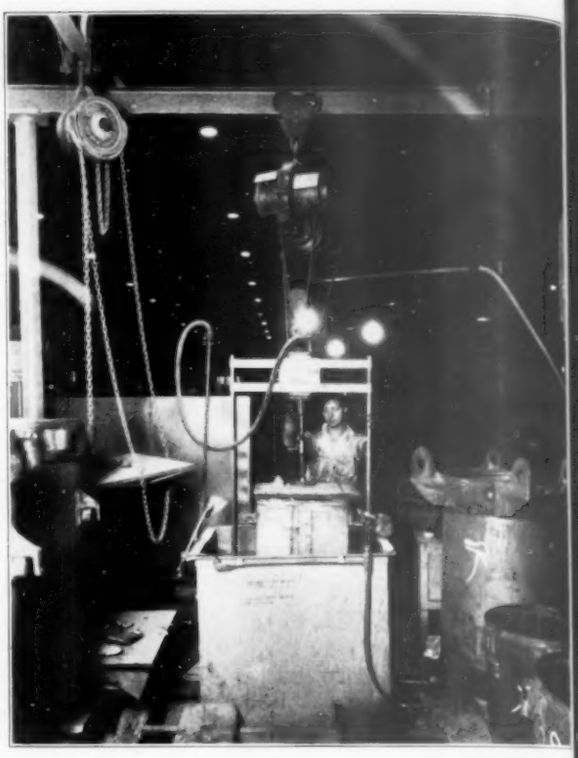


Figure 13. Inspecting Tanks by Immersion.

short circuit, are put under oil pressures of 150 pounds t 600 pounds per square inch.

Soap and Bubble and Hot Oil Test for Thin Sheet Tanks. The test of regulator tanks, made of corrugated sheet ste requires a special set-up. Many tanks have to be handled, and their material is relatively thin, in order to enable ea forming of the corrugations. There is a large amount o welding on the regulator tank, not only at the top and bo tom, but also at the sides, as there are several sheets re quired in the making of the tank; in addition, nipples mus be inserted in the walls. The beads along the top an bottom can only be small and practically amount to a me

Figure 14. Air Test of Regulator Tanks.

ing down of the sheet material. The tanks are subjected firs to a soap and bubble test. Air pressure of five pounds i used. Regulator tanks are built in large quantities with a steady load the whole year around, which makes it advisable to provide every facility for testing. The tanks are lined u racks. A special top had been worked out, which is handle

a chain hoist, running on a track, as shown in Figure 14. e top is pressed on by two cylinders supplied from the line at approximately 70 pounds. The examination by soap and bubble test is so effective that leaks are rarely covered on the next test, which is carried on under erating conditions. The tanks are filled with oil of approximately 90° centigrade. Tanks are generally removed om the racks after 24 hours; if leaks show up, the time is tended to 48 hours. The pump is used again to return the back to the large storage tank. The combination of the o tests, namely, the soap and bubble test and the hot oil oved worth while.

Test of Vacuum Tight Tanks. The test for vacuum tight nks for mercury-arc rectifiers is extremely important. The side shell and all its connections must hold vacuum, while e outer shell must be water tight, the space between the o is used for water cooling. The basical law of design, that nothing is acceptable unless it can be tested and repaired, must be very strictly observed with this type of apparatus. All parts for the rectifier are separately tested, in addition, all the vacuum pumps and accessories are subjected to a frequent check up. The inner shell, which holds the vacuum, is first put under the soap and bubble test; air pressure up to 80 pounds is used; somewhat less pressure is applied for the shell that holds water, only. Under vacuum, the first tank or the assembled apparatus must not show a leakage of one-half to one micron per hour, depending on the size of the equipment. A micron is 1/760,000 of an atmosphere.

There is a demand for commercial test that will eliminate the personal factor in determining the quality of a finished weld. There have been applied X-rays, stethoscope and magnetic measurements. It is too early to decide if these laboratory methods will find use in daily production.

732 Mile Pipe Line Is Welded

A new long-distance pipe line which will be used for the ransportation of petroleum products from the oil fields f Oklahoma to the Gulf refineries located in Ohio and Western Pennsylvania, has recently been completed. This ne, which originates in Perryman, Oklahoma, was conructed by the Gulf Pipe Line Company of Pennsylvania. consists of a main line 732 miles long constructed of 0-inch pipe, and a branch line of 8-inch pipe, 51 miles long. The main line of this project runs from the oil fields of Oklahoma to Spencerville, Ohio; thence to Toledo, Ohio, and Pittsburgh, Pa., by way of the old Buckeye Pipe Line Company's line. The branch line is taken from the main line at Dublin, Indiana, and runs to the Gulf refineries at Cincinnati, Ohio.

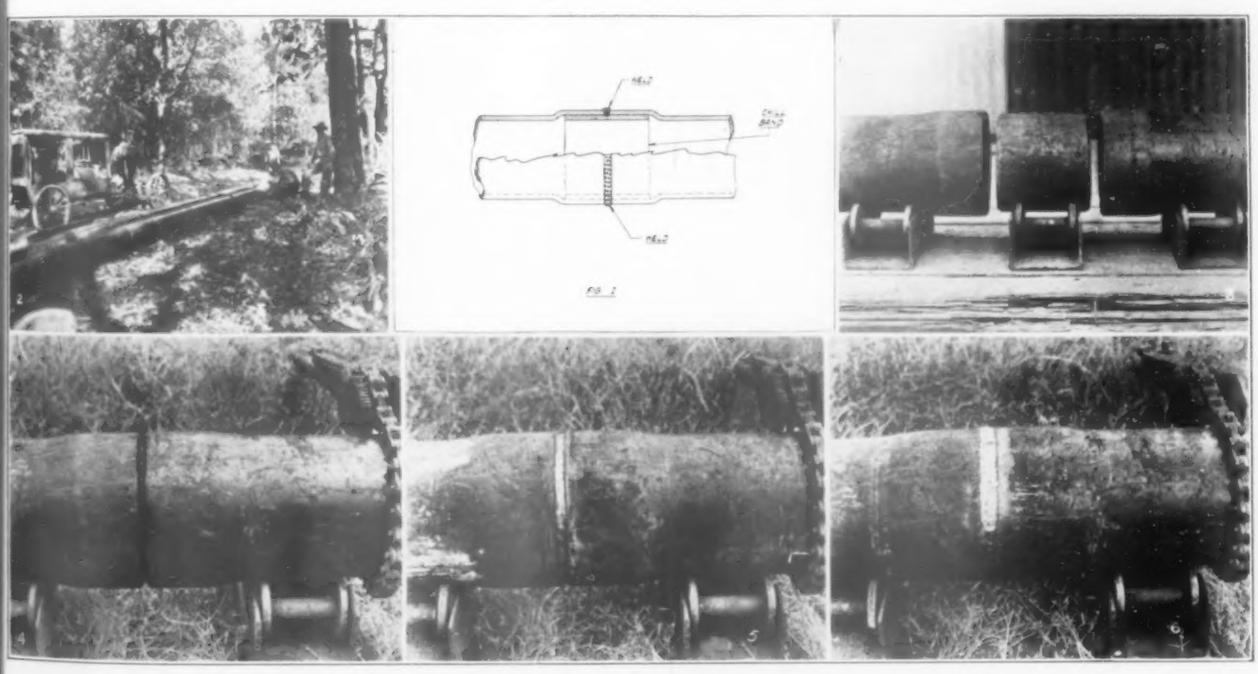


Figure 1—The Weld Fuses the Pipe Section Together and to the Chill Band Making the Entire Line One Integral Steel Unit. Figure 2—Showing an Operator Making a Firing Line Weld on the Gulf Pipe Line. Figure 3—Showing the Double Bell and Chill Band Joint Before Being Completed. Figure 4—The Joint Complete Ready for Arc Welding. Figure 5—The Burning-in Bead in Place. Figure 6—The Completed Joint Just After the Finished Bead Was Completed.

The construction of this new line involved arc welded joints in the firing line. National seamless tubing and lap-welded standard pipe, equipped with double bell and chill band joints, were used. The pipe lengths averaged approximately 40 feet and weighed 40 pounds per lineal foot. Each pipe length is belled at both ends and the ends are beveled so that in arc welding the joint the weld penetrates through to the chill band, as shown in Figure 1.

Before the construction of this new line was begun the Gulf Pipe Line Company conducted a series of tests of arc-welded joints for pipe line work. As the result of these tests the "Fleetweld" process, a recent development of the Lincoln Electric Company, was adopted for use on the new line. This process also allows the welding to be carried on at a high rate of speed. In a number of cases operators completed more than 50 welds per nine-hour day. Figure 2 shows an operator making a firing line weld.

As sections of this pipe line were completed they were tested for tightness in preparation for turning the oil into the line. The section from Spencerville, Ohio, to Dublin, Indiana, distance of about seventy-eight miles, was tested

with air at 130 lbs. per square inch, and only one small pin hole was found. This hole was repaired and the pressure was kept on the line for four successive days. At the end of the four days the pressure had dropped only ½ lb. On another section of the line, Dublin, Indiana, to Edgewood, a distance of about 193 miles, the line was tested to a pressure of 100 lbs., and no leaks were found.

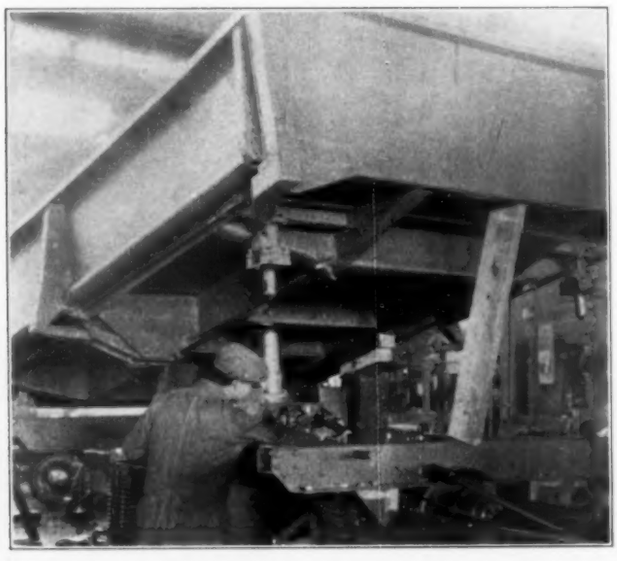
The result of these tests indicate the thoroughness and constructive ability of those in charge of the building of the Gulf Pipe Line Company's line as well as the efficiency of the welding process which they employed. Through rocky country, desert sand, hills, gorges, rivers, marshes and forests, in all varieties of weather this line was pushed to a speedy and satisfactory completion.

The method of lining up the pipe and completing the firing line welds is shown in Figures 3, 4, 5 and 6. Figure 3 shows the chill band in place in one pipe length just before the joint is completely lined up for welding. In Figure 4 the joint is completed ready for welding. In arc welding the joints on the firing line two beads are used. The first bead, shown in place in Figure 5, is made with a quarter-inch electrode. This bead is followed by the finishing bead, made with a ⅜-inch electrode. Figure 6 shows the finishing bead in place. About 10 minutes are required to complete one of these joints.

As is customary in pipe line construction the pipe was lined up on sections for welding, and the pipe turned as the weld progressed. These sections were then rolled over the ditch and welded into place on the line. The sections vary in length from 5 to 12 pipe lengths depending on the terrain.

When completed this pipe line will be served by 14 pumping stations, each equipped with oil engine driven reciprocating pumps. The line will have a working pressure of approximately 700 pounds per square inch, and a capacity of 35 to 40 thousand barrels per day.

All Steel Welded Dump Body



Installing a Welded Dump Body and Lift.

Woods Hydraulic Lift dump bodies, extensively used for heavy hauling jobs, are substantially built steel bodies, practically all electric welded. Housing of the lifting jack, which is made separately, is also made by electric welding. Photo shows body and lift being installed on a Coleman four wheel drive truck chassis.

Canning Plant All Arc Welded

An interesting application of structural welding was found in the all-welded building recently constructed for a canning plant at Largo, Florida. As indicated in the photograph the design is such that this type of building would be well adapted for an airplane hangar. The building is 140 feet

Reduced Erection Time Was Noted in This Welded Factory.

in width, 175 feet long and 38 feet high. Mr. R. G. Wilson, District Manager of the Burdett Oxygen Company, who forwarded the photographs, states that the use of welding speeded up the construction of this building considerably. In fact, it was estimated that the job was completed in less than one-half the time which would have been necessary for a riveted job. All the steel work was fabricated and welded at the site of the building, the work being done by Wolfe Bros., 442-44 Calhoun Street, N. W., Atlanta, Ga.

Saw Welding Taught to Lumbermen in Oregon

Sponsored by the Portland branch of Disston Saw Company, and under the personal instruction of Mr. E. A. Jordan of Smith Welding Company, Portland, Ore., some ten representatives of the leading lumber companies of Oregon received a week of instruction in saw welding, and which proved most successful and lays the foundation for future weeks of similar instruction later.

On the final day of the week, operations were switched from the Disston plant to the Palladay Welding Shop, where the list of representatives were increased and the entire procedure of advanced saw welding was given.

Among the companies represented were Hammond Lumber Co. of Mill City; Oregon Lumber Company, Dee, Ore.; East Side Lumber Co., Portland; Multnomah Lumber & Box Co., Portland; Eagle Lumber Co., West Timber, Ore.; Oregon-American Lumber Co., Vernonai, Ore.; Eastern & Western Lumber Co., Willamette Valley Lumber Co., Dallas, Ore., and the entire mechanical force from the Weyerhauser Timber Co., Longview, and Matt Fran of the McCormick Lumber Co., St. Helens.

A similar week of instruction from Mr. Jordan was given to a class at the Disston Saw Company in Seattle starting Jan. 21st.

Economics of Gas Welded Pipelines*

The Savings Made in the Installations of Main Lines Are Closely Paralleled by Those Made in Service Lines and Maintenance

By Erick Larson†

THE facts and opinions on the art of welding as brought out in the following article are the result of an intensive study of some typical transmission and distribution systems of the East. They are from the viewpoint of the operating executive rather than from that of the technical expert. Much of the material herein contained is similar to that included in the Empire Gas and Electric Association's Gas Distribution Committee Report to the 1930 Gas Section Convention held at Elmira, N. Y. This report was composed by the writer for the committee.

As a result of the extensive discussion as to what constitutes an acceptably tight distribution system, it was decided to investigate (1) the causes of leakage in a line and (2) whether it would pay to repair the slightest leaks. Since the most interesting results were found to be in connection with the uses of steel pipe and with the advantages of welding pipe lines, this report will be limited to these two factors.

Steel pipe sections were selected for several reasons. In the first place they are generally used throughout the country. Also many companies are being forced to change from their all cast-iron policy to wrought iron or steel because of the modern high-pressure systems now being installed. And finally, the uses and features of cast iron are common knowledge, while steel still requires educating the public to its advantages. Steel piping is nothing new in certain classes of industry, for it has been in use for many years in the oil fields.

Materials Must Be Studied From Every Angle

At present practically all steel pipe used in gas lines is of lap- or butt-welded, longitudinal seam type. Because of this, split seams, and porous or laminated pipes are of relatively common occurrence. However, the manufacture of seamless tubing is rapidly developing to the point where its higher cost does not overbalance its advantages. As its application is extended, undoubtedly the price level will be brought down more nearly to that of the longitudinal seam type. Nevertheless, the present existing difference in price between the seamless and other types of pipe calls for study in order to determine which is the more economical.

Tests made by the Bureau of Mines on numerous pipe lines indicate that the least leakage may be expected from a properly constructed welded steel pipe line. The question arises as to why there should be any leakage in a line in which every joint has been tested and the type of construction is such that the line is one continuous length of pipe.

Many times cheapness of construction leads to the use of unsuitable joints, when a more thorough study of leakage and maintenance costs would have revealed no economy in the long run. We are too prone to accept the word of some designer or operating engineer that his type of joint never fails. But the main foreman repairs many leaks about which the manager never hears. It is far better to conduct some research and study as did the Bureau of Mines when they advocated welded steel piping.

Welding has been more or less limited to the oxy-acetylene process because of the greater experience available in its use. In the field of oxy-acetylene welding the scientific thought and effort put forth not only in original development but also in the perfection of a procedure control is an example for any industry to follow. It is the direct reason for its success. Firms manufacturing welding equipment employ corps of engineers not only for the purpose of instructing new welders but also for the solution of unusual problems and for the continued study of the science of welding. However, it still remains necessary for the local manager and engineer to have a thorough knowledge of the science of welding so that the proper principles may be passed on to those doing the actual work. Furthermore, the high morale necessary in the actual welder and his immediate superiors must be properly understood. The human factor plays an important part in welding, and a welder regularly instructed and encouraged pays dividends.

The Welded Gas Line Is Practically Free of Leakage Losses.

Reduction of Wall Thickness May Be Possible

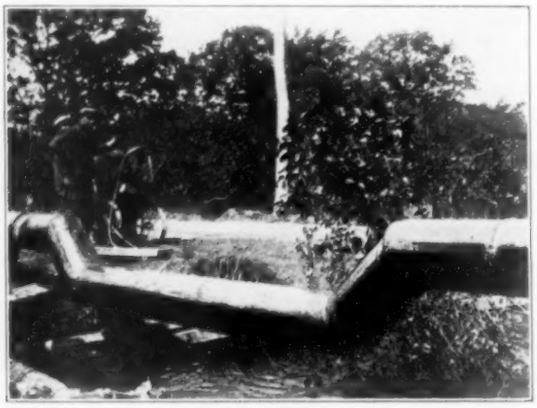
For all the excellent theoretical work that has been done in the computation of the internal stresses of lines placed underground, nothing as yet has exceeded experience. Both standard and light weight steel pipe have been laid under many conditions carrying gas and hydrostatic pressures that bring the internal stress of the pipe to within 75 per cent of its elastic limit. After years of service in the southwest such pipe lines have yet to develop any trouble in the pipe itself. While such a close margin of reserve strength is not to be recommended, still it does indicate that theoretical computations must be tempered with experience. There never has come to the attention of the writer a single instance of a circumferential break in a steel pipe except at points of weakness where threads and grooves are cut into the pipe for certain types of couplings. This fact indicates that a more thorough theoretical knowledge of stresses entering into pipe line construction may lead to considerable saving by cutting down wall thicknesses. Since temperature and line pressure stresses lend themselves to mathematical exactness, some of the more intangible factors found will be enumerated.

One of the largest stresses to which any pipe may be subjected is that due to temperature changes, a large proportion of which arises at the time of laying. On a hot sunny

*Read Before the 51st Annual Convention of the International Acetylene Association, Chicago, Ill., Nov. 12, 13 and 14, 1930.

†Superintendent of Gas Distribution, Long Island Lighting Company, Bay Shore, N. Y.

day in New York State actual tests have shown the not uncommon temperature of 110 deg. F. of the pipe itself, while the ground temperature at a depth of 2½ ft. is but 60 deg. F. Proper laying will overcome most of the stresses resulting from such abrupt temperature changes, however. If the burying of the pipe proceeds from one end only, and the end toward which the burying proceeds is free, natural contraction will be taken up by movement of the free end



Where Changes of Direction Are Necessary, Gas Welding Provides Them Without Delay.

of the pipe. This overcomes stresses which in a pipe rigidly fastened at both ends would have to be taken up internally. In the March 9, 1929 issue of *Gas Age Record* there was an article entitled, "Ground Temperatures Obtained at Varying Depths at Schenectady, N. Y." In a summary the following results were shown:

MAXIMUM GROUND TEMPERATURES

5 ft. Cover	August	57 Deg. Fahr.
3 ft. 6 in. Cover	July and August	59 Deg. Fahr.
2 ft. Cover	July	66 Deg. Fahr.

MINIMUM GROUND TEMPERATURES

5 ft. Cover	March	23 Deg. Fahr.
3 ft. 6 in. Cover	January, February, March	22 Deg. Fahr.
2 ft. Cover	February	14 Deg. Fahr.

From the standpoint of strength, this survey would indicate that burying to a depth of only two feet would be an economically sound proposition. The added stress caused by the difference between 22 deg. and 14 deg. F. is only 1560 lbs. per sq. in. This stress is based upon a modulus of elasticity of 30,000,000 and a co-efficient of expansion of 0.000,006,5. Taking the maximum differential and using the same factors, the stress due to the difference in temperature between seasons would be 10,140 lbs. per sq. in. For still greater extremes, let us assume a differential temperature of 100 deg. maximum in order to allow for poor conditions at the time of laying. The temperature stress would then be 19,500 lbs. per sq. in. Taking a gas pressure of 60 lbs. per sq. in., a pipe diameter of 6 in., and a pipe wall thickness of ¼ in., the stress from this source would be 720 lbs. per sq. in. In the Southwest, pressures as high as 350 lbs. per sq. in. are being carried in standard weight pipe lines. The stress due to gas pressure is at right angles to the temperature stress, so that the resultant stress would have to be figured by the theory of the ellipse of stress. This resultant stress still leaves 10,000 lbs. per sq. in. under the elastic limit of steel to take care of the stresses of unknown magnitude caused by the motion of the earth from the frost action, loads imposed vertically over the main of sufficient intensity to cause the main to act as a beam, and bending during laying. Practice has proved that this margin of safety is sufficient.

From this study it must not be assumed that it is recommended to bury a pipe to a depth of 2 ft. Other factors enter that again show the necessity for study beyond actual design and construction. Where gas is pumped for more than a mile, actual field tests have proved that there is practically no difference between the ground and gas temperatures. In most plants the gas sent out is corrected to the standard condition of 60 deg. F. However, the Schenectady survey shows the ground temperature over a period of several months of the year to be at an average of 20 deg. F. As a result of this 40 degrees difference between send-out temperature and sales temperature, there is an 8 per cent loss in the quantity of gas delivered which is shown up as unaccounted for gas. The above survey indicates that the temperature would be above 60 deg. at the two-foot level for only a period of two months during the year. During these two months the average temperature would be about 62 deg. F. A similar study in the Southern part of the State over a period of two years gave a maximum temperature average of 66 deg. and a minimum of 42 deg. at the two-foot level, for the temperature of gas in the main. These figures were taken at a distance of 4½ miles from the plant. Simultaneously, a test determined that the gas a mile from the plant was at ground temperature.

The use of any type of so-called expansion joint to take care of temperature changes has not been mentioned for two reasons. In the first place it was desired to show extreme conditions. Furthermore, a study of lateral movement of buried pipe in the ground, as reported in a booklet entitled, "Controlling Temperature and Bending Strains in Bronze-Welded Cast Iron Pipe Lines," by E. Hering, F. G. Outcalt and T. W. Greene, published by The Linde Air Products Company, proves that an expansion joint is not as effective as is generally supposed in relieving temperature stresses even as close as 100 ft. from the joint because of the high frictional grip of the soil.

Further Aspects of Loss Should Be Studied

Studies and tests which have been made show why there is some leakage in a welded steel line even though every joint has been given a soapsuds test. As a result, it is recommended that tests should not be limited to joints alone, but that methods of detecting other leaks should also be employed. All sections, where possible, should be tested above ground by means of a soapsuds test of the joints and a closed-in pressure drop test of at least three hours to indicate any major leaks. The coating should then be applied and the pressure drop test repeated in the trench before burying. After burying at least a 24-hour drop test should be made. The slightest indication of a drop in pressure should be the signal for a test lasting until it is determined that the drop is not due to temperature changes or to a leak at the cock where air is pumped into the main. In case of a drop, the section should be divided into convenient lengths, and tests should be applied to each. As the sections become shorter, the leakage becomes more noticeable, so that when the trouble is located and the pipe dug up, the actual leaking piece of pipe can be repaired or replaced. If the leak is caused by a split seam, it can be welded in place, but usually it will pay to remove the section as the part repaired may not be the only leak. The argument that this large expense is not warranted when the small amount of leakage is considered may be answered by considering the sum total of the leakage loss and by the danger of subsequent property damage suits where shrubbery and trees are apt to be injured.

Successful Record of Welded Mains

The advantages of complete welding and careful testing have been clearly shown on one system of over 600 miles of distribution mains. Work done has involved gas welding of all mains since 1926, and all services since 1927; including some replacements and the welding of about 10 miles of pipe originally screw coupled. Property damage of shrubbery and trees on new work has been eliminated. Although

the system has been increased 25 per cent in extent during that time, the actual volume of unaccounted-for gas has been cut 37.5 per cent. Whenever a leak has been found on any type of coupling, the repair has been a solid welded job.

The following is a summary of results obtained through the study of the uses of steel pipe:

The use of standard weights and sizes of pipe is recommended.

The placing of light weight sections in a variety of conditions and locations is desirable for securing test data.

At present standard weight lines are carrying pressures as high as 350 lbs. per sq. in.

From strictly the viewpoint of strength the depth of burial of line is not a major factor with steel pipe under temperature conditions prevalent in New York State.

Where care is taken to secure a joint equivalent in strength to that of the pipe, expansion joints are unnecessary.

Lap-welded pipe is preferable to butt-welded, and seamless is preferable to both.

Thorough testing of lines after joining is recommended including the pipe itself.

Oxy-acetylene welding was known experimentally for many years previous to its practical use. Gas welding secured international fame through its use at the Panama Pacific Exposition and through the medium of an article entitled, "Welding in Gas Distribution," in the *Gas Industry Magazine*, September, 1915, by Mr. D. E. Keppelman, of the Pacific Gas and Electric Company. Because of the far-sightedness of the engineers of the Pacific organization, this article is actually history written years in advance. The article is a milestone in the history of welding.

Records show that in 1911 the Philadelphia and Suburban Gas Company laid an 11-mile line south of Philadelphia. From then until 1919 there was a steady increase in the number of companies using the process. In 1919-1920 another milestone was reached. The Prairie Pipe Line Company welded 15 miles of 8-in. oil line to carry 700 lbs. pressure. This was engineered by Mr. Noah Wagner, Superintendent of Welding. In 1922, the same company, thoroughly convinced of the advantages of gas welding, laid the longest all-welded line up to that time. It was 104 miles in length. Since then the practice of welding oil and gas lines has become standard practice.

A Least Cost Factor

It would appear that little need be said of the advantages of welding, but during the past year a number of requests have been made for such information. In general it might be said that there is no limit to welding, since it is used from the largest undertakings to that of the solitary blacksmith in his little shop. However, there are numerous outstanding advantages of oxy-acetylene welding in pipe line construction.

In the first place, specials may be made up in the field to fit exactly. Tie-ins with existing piping may be made without cutting the old lines or without the use of expensive and clumsy clamps. This applies to inside as well as outside work. For example: welding is a time saver in the placing of an aquastat or pressurestat during the installation of gas house-heating units. A short nipple is welded on the take-off lines near the boiler without necessitating cutting of the line or chancing breakage of the plugs in the boilers. Other applications may be found on large water heating jobs, house heating jobs, difficult house lines and meter headers, intricate bends in main work, and many places where problems arise in which a welded joint proves to be the difference between profit and loss.

Architects are rapidly realizing that the greater ease in detailing a welded rather than a fitted job is a sufficient reason to specify welding. Not only are the fittings or pieces required cut to a minimum for the estimator, but also the time required in the field for the checking and reporting of inventory is lessened.

The welded joint is the lightest type of joint for steel pipe. Welding eliminates the necessity of ordering an extra heavy or an upset end in order to allow for structural weakening from the threading. On large jobs the lowering of freight and transportation costs due to the lighter weight results in considerable savings.

Type of joints that are threaded or require a depression being turned in the pipe cause a weakening at that point. Practically no type of joint will give the uniformity of strength possible with welded joints under all conditions.

Greater Flexibility Is Possible

The use of other than welded joints is sometimes specified for long transmission lines for the reason of the greater speed with which the line may be laid. However, the use of a greater number of gangs in laying pipe will overcome this difficulty. In fact, the installation of distribution mains, services and detail work, together with much of the larger interior work will average less time with welding than with screw joints. This is true because the welder is not held up while pipe is being threaded. If it is not possible for him to continue his work in the direction he started, he can easily go to the other end of the line or to some other point. This eliminates much work in the final tie-ins. When these tie-ins are made, a slight or even noticeable misalignment offers no particular difficulty.

There is no hold-up in work while waiting for regular or special tools, since the number of tools required is a minimum.

The better conditions under which the tie-in gangs can proceed is also a great time saver. Several sections can be welded in convenient places , put in position, and then welded together in the trench or on a scaffold. The saving in time that results greatly lessens the cost of scaffolding and bell holes.

Changes and additions to a present pipe line system are also simplified by oxy-acetylene welding. A regular pipe fitter usually dislikes to reconstruct or add to an old layout. When the cutting torch and the welding blowpipe are used changes are more easily and more cheaply made.

Method of Closing the End of a Line to Be Tested.

Whether the pipe is to be covered with a regular steam pipe insulating covering or just painted, the absence of any type of fitting makes the job less expensive. Also, the finished work is neater in appearance.

Actual tests run by the Bureau of Mines prove that in a welded line the flow of water and gases more nearly approaches theoretical perfection than with any other type of joint.

With welding, the material transported by the pipe will

have no more effect on the joint than on the pipe itself. Other forces such as expansion and contraction, vibration, chemical properties of the soil, strains left in laying or produced by settlement of the trench, earth movements and changes of pressure carried, leave no worries as to how the joint will act. With changing characteristics of gas loads, the fact that pressure conditions can be altered is a factor of major importance and one that is resulting in high pressure distribution even in cities.

Long Trouble-free Life

In all but welded-joint lines, leakage will naturally increase with age and pressure. If there are any existing leaks in the welded line the leakage will increase in proportion to the pressure carried in a manner similar to that of an orifice. In the case of mechanical joints, the leakage will increase considerably in excess of that from a straight orifice because the tendency of the pressure will be to open up the joint. Certain types of rubber or composition packed joints are designed on the theory that added gas pressure will force the jacking still tighter against the walls. Tests have proved that the mechanical joint lines of this type not only have the leakage increased in greater proportion than on welded lines, but also on tests at a reduced pressure made after the high pressure test, leakage has increased above that originally found at this lower pressure.

The argument is often used that the human factor in the welding of a joint is greater than that in the making of a mechanical joint. A simple test can be made to show that in any mechanical joint this human factor is just as great. A mechanical joint under pressure can be made up to the point where no leakage is indicated either by hand or by light application of a wrench. The ease with which leakage may be overcome in this test clearly indicates what may happen on a carefully inspected job that has been in the ground for only a short time. The forces to which a line is subjected will soon discover the weak point. While this is by no means a condemnation of mechanical joints, still it is a reminder that even a machine must have a human operator. The severe handling that a welded line receives before it is finally buried, without, of course, deliberately straining it, is one of its best tests.

Welding has gone through its development period in the past twenty years. It cannot be said to be perfect. Comparatively speaking, it has reached a state of perfection that is envious in the realm of joints. Our aim is to have each joint approach or equal the perfection that we know is possible. There are ways and means of securing the desired results that engineering ability and considerable field experience have shown to be possible.

Dates Announced for Boston Show

Announcement has been made by W. H. Eisenman, secretary of the American Society for Steel Treating, that floor plans for the 13th Annual Metal Exposition have been mailed. The exposition will be held this year in Boston, at the Commonwealth Pier, during the week of September 21.

Commonwealth Pier is an unusually good location for a show of the size of the National Metal Exposition. The large amount of floor space and good ventilation, combined with the Pier's accessibility to downtown Boston, have definite advantages for exhibitors and visitors alike.

Plans already under way indicate that the 1931 Metal Exposition will be one of the most successful in history, both in size and in variety of fields covered by the exposition.

Boston, as the center of the New England Manufacturing District is expected to produce an attendance at the exposition well in excess of 60,000, while registration at the technical session of the National Metal Congress will probably run over 6,000.

The American Society for Steel Treating has the full cooperation of the following societies as joint sponsors of the National Metal Congress: American Welding Society, the Iron and Steel and the Institute of Metals Divisions of the American Institute of Mining and Metallurgical Engineers, the Iron and Steel and the Machine Shop Practice Divisions of the American Society of Mechanical Engineers and the Gas Products Association.

Obituary: Daniel H. Deyoe

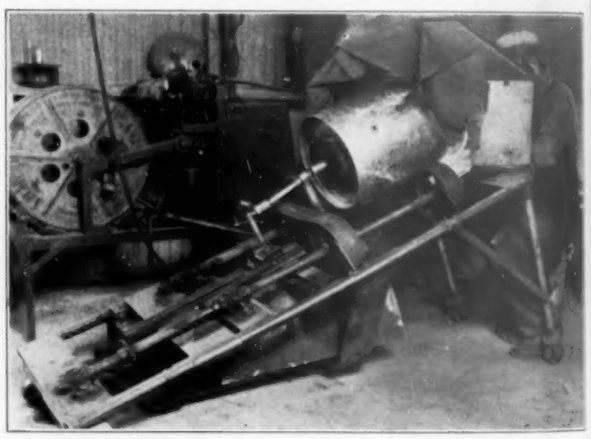
Daniel H. Deyoe of the industrial engineering department of the General Electric Company, a director and member of the American Welding Society and a figure for many years identified in electric arc welding activities, died in Schenectady, April 11, at the age of 55.

Mr. Deyoe was a graduate of Union College, class of 1898, and joined the General Electric organization in the same year. He became affiliated with the industrial engineering department in 1906, soon became active in arc welding problems, and has been an outstanding figure in that field ever since.

Semi-Automatic Welders for Tanks

By Gerald B. Burtnett

To overcome difficulties in securing a uniform weld when joining a concave top to a water tank, the Day and Night Water Heater Co., at Monrovia, Calif., is using a semi-automatic type of welder. The tank is placed at the proper angle on revolving rollers and turned at an even, slow speed



Welder at Work with the Semi-Automatic Equipment.

by an electric motor through a chain, shaft and belt drive combination. The welder holds his electrode at one set position and completes his operation as the tank revolves before him. Production has been speeded and more satisfactory work turned out since installation of the machine.

Welded Vibrator Machinery Stands Severe Test

By Jos. C. Coyle

Constant use of machinery in production, under widely varying conditions—heat, cold, dry, and wet—is a decisive test of the unit's efficiency and that of the methods used in its construction. Traylor vibrating screens and conveyors are made by the Traylor Vibrator Company, of Denver, Colorado, who use continuous electric welding with great success. The materials handled, such as ore, concentrate, coal, coke, cement, slag, gravel, and sinter indicate its wide range of usefulness. The screens and conveyors are made in many sizes, lengths, and types to comply with the various needs of industrial plants.

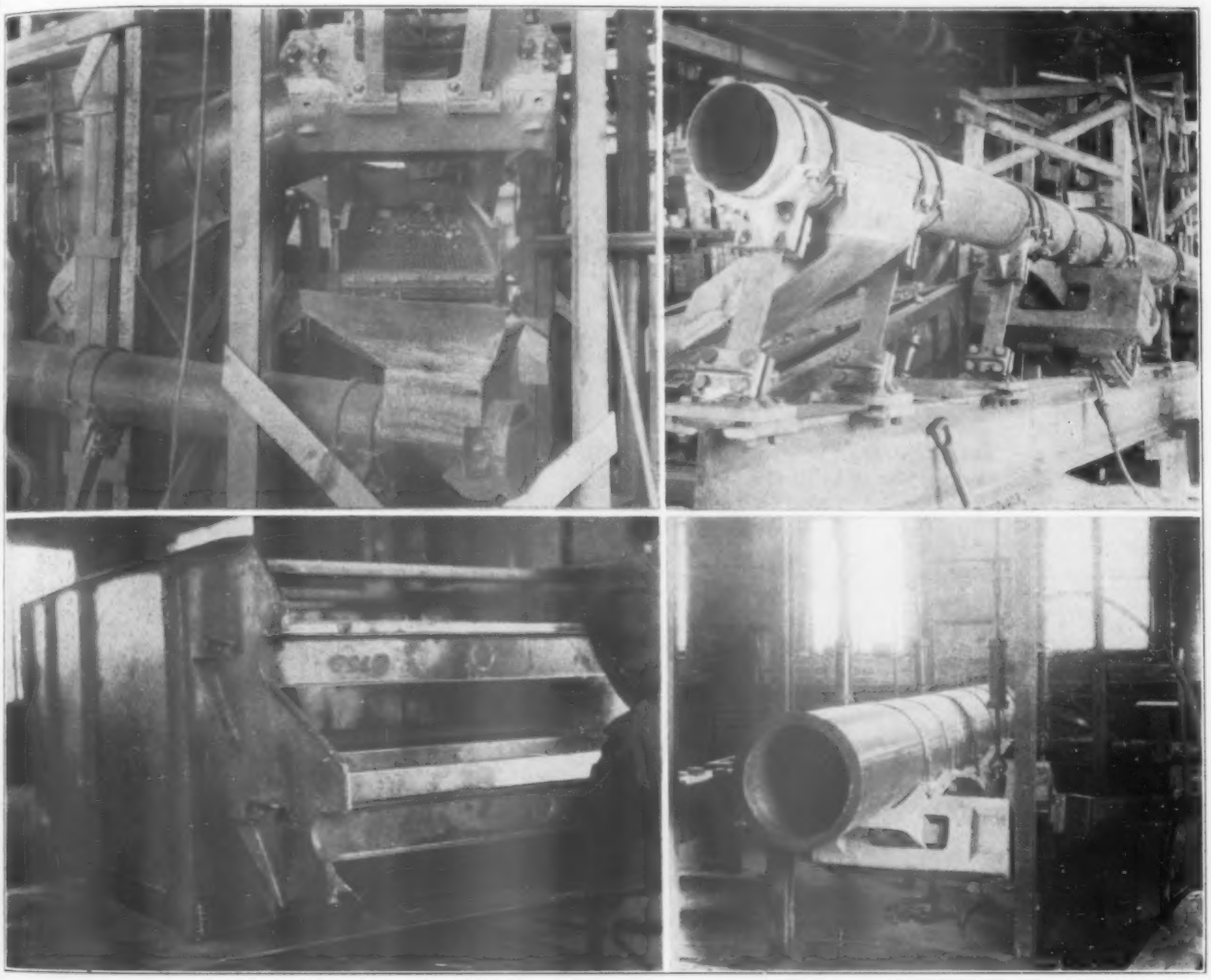
A vibrator consists of three principal parts: First, a unit to be vibrated which is suspended freely in space; second, a main frame to counterbalance the vibrated member; third, an energizing unit. Each of these three parts will be discussed below.

The unit to be vibrated can be either a screen sash—single or double deck—or a pan or tubular conveyor. The welded sash must be rigidly constructed to stand ⅛ inch reversal 1200 times each minute. The sash is usually made of 10 gauge open hearth sheet steel, cut to shape on square shears, and bent. The sides and cross sections are then joined by a number of metal clamps and tack welded together. The clamps are then removed and a continuous bead run along the joints. Likewise, the tubular or pan type conveyor must be absolutely rigid. The tube is usually of ¼ inch open hearth steel, cut on square shears, and rolled to shape. The edges are drawn to within ⅛-inch and tack welded after which a continuous bead is run and the same built up approximately ⅜ inch on the outside to reinforce the belt.

Variation in the type of construction and material is imperative, as these conveyors sometimes handle material up to 2000 degrees F. On such hot material a water jacketed cooling conveyor is used which consists of an inner and outer shell. The two are joined by electric welding. The outside, however, is applied in sections joined to the inner shell by projecting strips of metal welded in.

The heavy main frame is drilled and tapped on a boring machine. It is then carried by crane to a shaper and the four corners made parallel to receive the steel vibrator bars. These bars are cut on a band saw. The spanner beam upon which the sash is mounted, which connects the two sides of the machine, is milled.

The energizing unit consists of a straight line synchronous motor. The laminations are cut and stacked and the motor coils are wound on a lathe. The coils of the motor are baked for 48 hours. These motors are mounted on each side of the frame and take a pulsating current from a small motor generator set which is furnished with both screens and conveyors.



Several Views During the Course of Construction of All-Welded Vibrator Machinery. The Manufacturers Find that the Welding Process Offers a Sturdy Economical Construction.

These vibrators are capable of continuous operation. Some of the vibrating screens handle as high as 800 tons per screen an hour. The tubular conveyors are capable of moving great tonnages on the level, downhill, or as steep as 18 degrees uphill. These machines are unique in that they have no wearing striking surfaces and require absolutely no lubrication. This equipment is used by mining and industrial plants with great success.

Welded Construction Reduces Failures of Bulldozers

Among the products of the Steelweld Machinery Company, Cleveland, Ohio, is a line of bulldozers, the frames of which are made of steel plates and shapes cut to size and welded together. The frame work is of heavy rolled steel plate and the bearing plates and side arms are also of steel. The principal advantage claimed for welded steel construction in this equipment is that the maintenance cost is lower because there are fewer failures.

Applications of Resistance Welding

Welded Tool Work—Welding High Carbon Steels—Applications to General Hardware—Forging, Bending, Annealing and Hardening

By M. L. Eckman†

The Present "Electrical Age"

FUTURE history will undoubtedly place the decade in which we now live, early in the "Electrical Age." Application of electrical principles speeded our commercial, business and personal communications past all anticipation by the development of the telegraph and telephone and more recently made all the world neighbors by development of the radio. Electrical principles speeded our means of transportation by the development of electric railways for passengers and freight. Our present high speed automotive travel would be doubtful without electrical ignition, lighting and safety devices. Development of the moderate priced electric motor and electric utility service made possible the "Mass Production Idea" in manufacture. Special alloy materials of vanadium, molybdenum, chromium, nickel, etc., are nearly all products of the electric furnace.

The "Electrical Age" has placed at the disposal of the world's manufacturers an "Assembly Method" that is equal in quality, reliability and speed to any of its other applications.

"Electrical Resistance Welding" applies electrical energy in a very simple and direct manner yet the welding is accomplished at high speed coupled with quality and low cost. Just three factors enter into "Electrical Resistance Welding", namely, alternating electric energy, time and pressure.

The application is accomplished simply by means of a machine designed to hold the work, conduct current to the welding zone and apply correct pressure. All resistance welding machines are designed on this principle.

Electrical Resistance Welding is divided into three classes: Seam Welding, Flash Welding and Spot Welding. Typical machines for these three classes of welding are shown in Figures 1, 2 and 3.

Let us consider some Flash Welding applications. While it is undoubtedly true that the repetitive manufacture of the same article yields biggest profits, it must be understood that resistance welding is not limited to this kind of work.

†*Research Engineer, Federal Machine and Welder Co.*

Machines Will Handle a Variety of Work

A 12″ lathe will handle a variety of work within the limits of its chuck or face plate. Likewise a resistance welding machine will handle a variety of work at no more loss of time than to chuck a piece of work in a lathe. The only difference is that it may take five minutes to chuck and true a piece in a lathe and an hour to do the work; whereas if it takes five minutes to chuck a piece in a welder, you may be sure it will not take more than 6 to 12 seconds to weld any ordinary work such as illustrated in this article.

Multiplicity of Work on the Same Machine

Any work from ¾″ to 2″ round may be handled on the same machine or its equivalent in square, flat, structural or special shapes, with no more inconvenience than chucking irregular shaped material in a lathe.

The publicity given to large production plants which have applied resistance welding with such benefit has led some to believe that it is not practical to do a variety of work on the same machine. This is a fallacy that is easily proven.

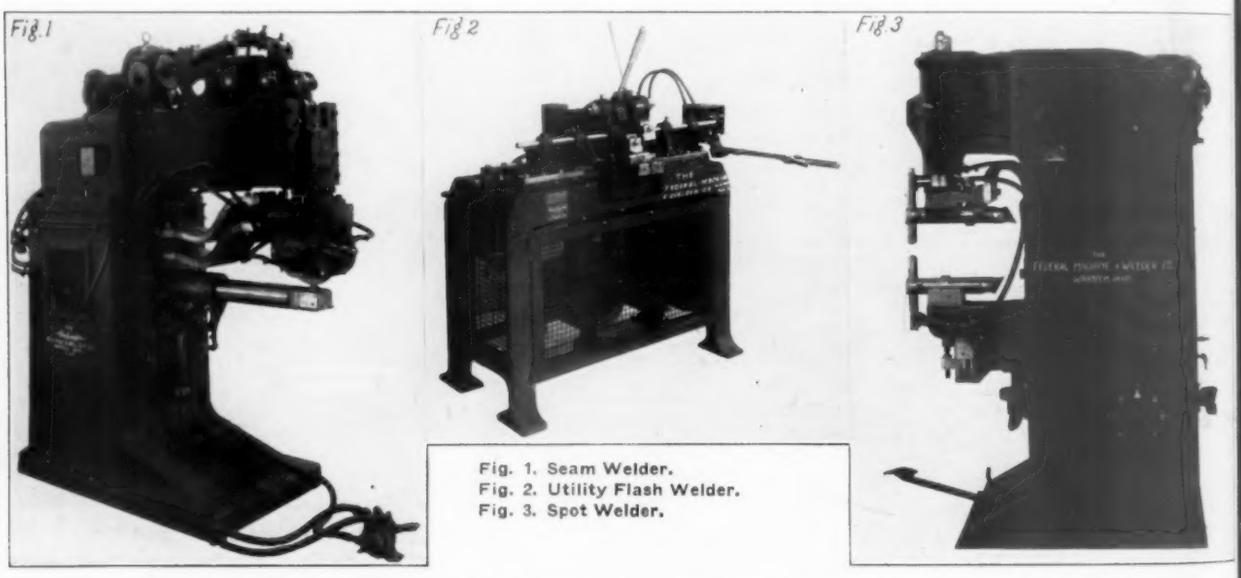


Fig. 1. Seam Welder.
Fig. 2. Utility Flash Welder.
Fig. 3. Spot Welder.

There are at present many small shops that make a handsome profit from operating one "Flash Welder" on general repair and job shop work. Other more pretentious establishments operate as many as 20 machines on jobbing and salvage work.

Welded Tool Work

Figure 4 shows the method of fabrication of an ordinary twist drill. These drills are usually made of high speed steel and welded on to a mild steel shank. About 95% of all high speed drills are manufactured this way. In shops using a large number of drills, tangs and shanks are twisted off all too frequently. It is only a few minutes work to take a round piece of steel as shown in lower sketch by heavy lines, turn a small neck on it and weld as shown. It is then remachined as shown by dotted lines.

Extension shanks of any length can be made for drilling deep holes. Taps may be lengthened any desired amount

(Figure 5.) Reamers are manufactured and may be repaired or lengthened as shown in Figure 6.

Broaches of all kinds, whether push or pull, round, square, spliced, key irregular or the formed broaches for external finishing of small parts are nearly all manufactured by resistance welding. (Figure 7.) Mild steel shanks are welded to high speed steel cutting body as indicated in these sketches.

Ample proof is at hand that all steels can be welded with some little study of conditions.

Procedure for welding high speed to mild steel is as follows:

Equipment 1—Flash Welder
1—Lead Pot at 1500 degrees F.
1—Mica Box and Flake Mica

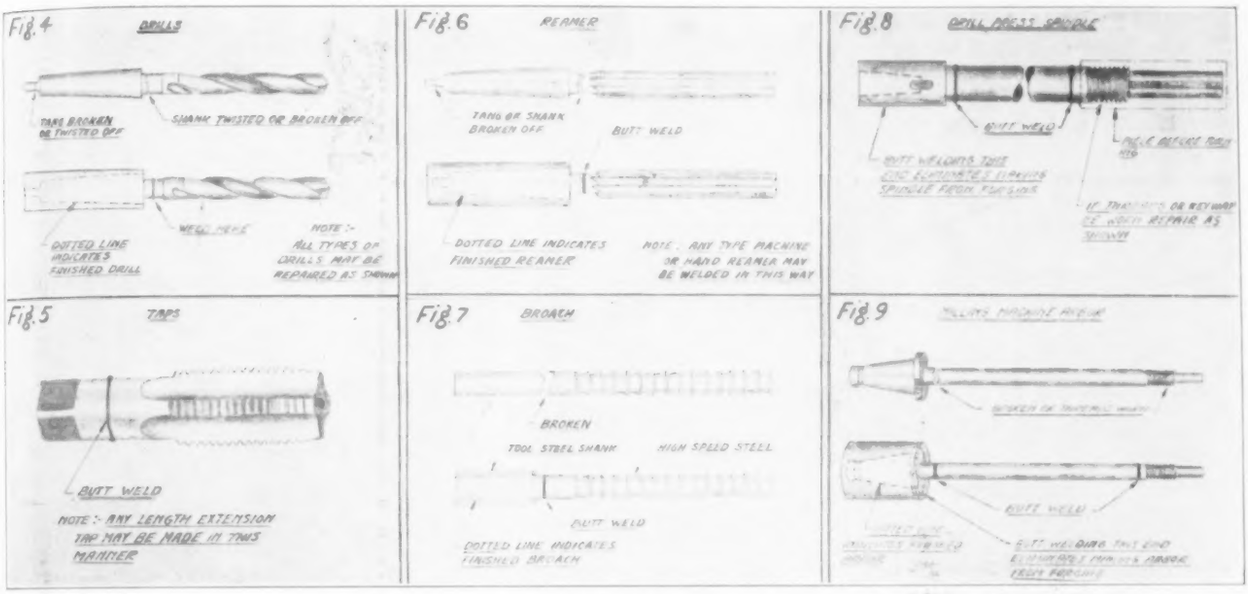


Fig. 4 DRILLS
TANG BROKEN OR TWISTED OFF
SHANK TWISTED OR BROKEN OFF
WELD HERE
DOTTED LINE INDICATES FINISHED DRILL
NOTE:- ALL TYPES OF DRILLS MAY BE REPAIRED AS SHOWN
Fig. 6 REAMER
TANG OR SHANK BROKEN OFF
BUTT WELD
DOTTED LINE INDICATES FINISHED REAMER
NOTE:- ANY TYPE MACHINE OR HAND REAMER MAY BE WELDED IN THIS WAY
Fig. 8 DRILL PRESS SPINDLE
BUTT WELD
Fig. 5 TAPS
BUTT WELD
NOTE:- ANY LENGTH EXTENSION TAP MAY BE MADE IN THIS MANNER
Fig. 7 BROACH
BROKEN
TOOL STEEL SHANK
HIGH SPEED STEEL
BUTT WELD
DOTTED LINE INDICATES FINISHED BROACH
Fig. 9
BUTT WELD

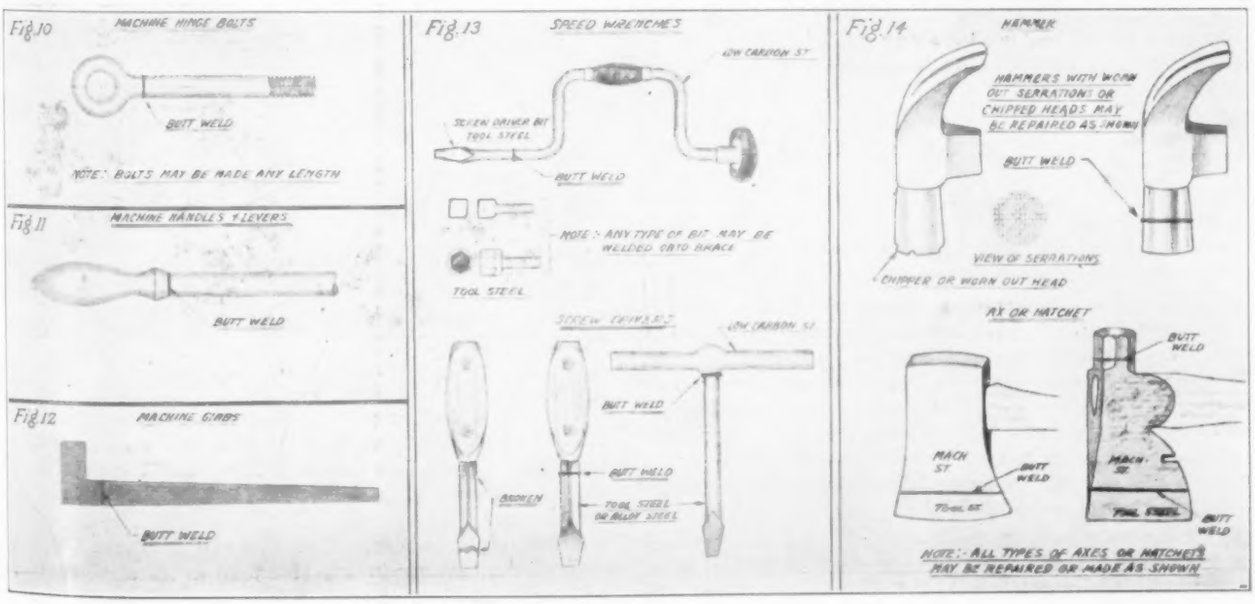
Machine Tools Manufactured and Repaired by Flash Welding.

Welding Different Analysis Steels

This brings up a point that it might be well to discuss. Nearly all of the commercial alloy steels are welded successfully. However, if a steel will air harden on removal from a critical source of heat, it will be even more brittle after electric welding, not due to any mysterious affect that electric current has on the steel but because the electric heat is quite local the adjacent cold steel acts as a chill, and causes extreme brittleness in such close proximity to the weld that some have thought the weld defective, and asserted that only the milder steels could be welded practically.

Anneal 1½" to 2" of high speed steel next to point where weld is to be made, by heating in lead pot and placing in Mica box to cool. Preheat mild steel shank to a dull red in lead pot, first, because high speed steel has greater resistance than mild steel and heats faster, second, so the mild steel will be a reservoir of heat, preventing chilling the high speed steel after welding. Proceed to weld, remove and place in Mica box to cool. After cooling, heat in lead pot an inch past weld on high speed steel part, and then let cool in Mica box. Such procedure will give welds equal in strength to the original metal.

Flash Welding Applied to Miscellaneous Articles of Hardware.



Machine Tool

Figure 8 shows a drill press spindle. In the early days we used to turn these out of solid stock. Then they were forged. Now we take stock $\frac{1}{8}$" larger than finished sizes and weld as indicated. 75 to 125 welds per hour can be made on this sort of work.

Milling machine arbors are manufactured or repaired as indicated in Figure 9. Figure 10 shows an eye bolt, the eye being a standard forging—any length bolt can be welded to the eye.

Machine handle forgings are welded onto levers (Figure 11) or hand wheels of all sorts. Machine head gib forgings are welded onto taper gibs of varying lengths as shown in Figure 12. 200 of these welds per hour are easily made.

General Hardware

Figure 13 shows how speed wrenches of various kinds may be welded to a brace. Note the method of upsetting handle of T wrench before welding. This also is done on a welding machine. Screw drivers are welded onto mild steel handles as shown, 250 welds per hour is a fair production figure.

Figure 14 shows claw hammers that may be manufactured by welding tool steel heads and claws onto mild steel bodies. Axes are now manufactured in quantities by welding. Tool steel bits onto mild steel bodies. Hatchets are also manufactured the same way and salvage departments in large manufacturing plants rework many tools by welding.

Worn pulley fits and key ways may be replaced by welding on new ends of shafts. Worn bearings may be replaced as well. Many costly delays in production may be eliminated by this means. It would take about 15 minutes to set an armature up and weld. If the shaft were pressed out and replaced, considerable longer time would be consumed. These are only a few of the articles that are welded. New applications are being made every day. There is plenty of room for originality in welding applications.

Special Applications

FORGING: Resistance welding machines are serving as forging machines in places where the production and variety will not warrant standard forging machines. Collars of various sizes may be upset on shafts or pins. Even hot headed bolts are made in this way. It has been found on some types of forge work that it can be heated by electrical resistance at 15% of the cost of oil or electric furnaces.

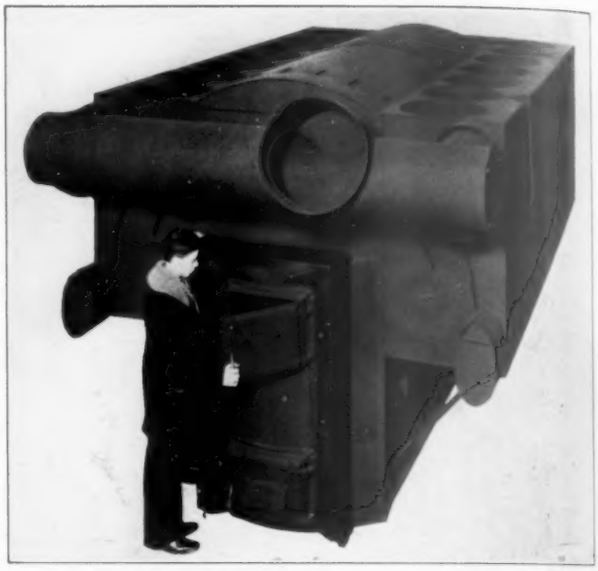
BENDING: One firm building electric locomotives on which there was a great amount of pipe bending, installed a resistance welder and used it along side of each locomotive for heating pipe and forming bends as needed. It is extremely fast, heating pipe from 1" to 3" in diameter in 3 to 8 seconds. Bending of structural shapes in fabricating shops is being done extensively on resistance welding machines.

ANNEALING: Localized annealing has been carried out successfully in jig, fixture and die work where the article must be annealed in certain local spots or areas to resist shock or for further machine operations.

HARDENING: Successful applications of heating uniform shaped details for hardening have been developed in which great speed and uniform heat is obtained at low cost. The uniform temperature obtained in each piece is truly remarkable. The machine is so designed that the current is cut off as soon as the detail has expanded a predetermined amount. We know of course, that the expansion is in direct proportion to the rise in temperature per degree. Exceptional close control is therefore obtained.

The resistance welding field is young, but development shows remarkable advancement. It must be remembered that a resistance welding machine is not confined to one line of work but many different sizes and kinds of articles can be welded on the same machine.

Mammoth Warm Air Furnace Is Arc Welded



This 10,000 Pound Warm Air Furnace Is All Welded.

The warm air furnace shown, one of the largest in the world, was fabricated by the arc welding process. It was built by the Campbell Heating Co., Des Moines, Iowa, for a large Rochester, Minn., church. Completed it weighs 10,000 pounds and has a capacity of 100,000 B.t.u.'s. In all it contains 482 feet of electric welding. The Lincoln Electric Shielded Arc was used in the fabrication of this piece of equipment.

Warehouse Uses Frame of Welded Pipe

With the strength of a weld on a machine, pipe line, or other construction generally known to be equal to that of the parent metal, new uses are constantly being found for this type of connection.

A Good Use for Old Pipe.

The accompanying photographs show a type of construction which is not uncommon but still new enough to be interesting. The joints in the trusses and uprights are all welded and the structural material is old used pipe and railroad rails.

Many larger buildings than these in Southern California shown here, have used the welded joint in the structural work with unqualified success.

Gas Welding In Production*

Its First Application in One Plant Solved a Major Production Problem, and Thus Paved the Way for a Large Scale Welding Program

By Earl C. Booth†

WE first entered the manufacturing field with the production of a high-grade automobile hand tire pump in 1919. This pump used tubing which was bought on the outside, threaded on either end, and screwed into the base and the cap. It was the deluxe tire pump of that time. In fact, it was called, "DE LUXE." These pumps were sold by special agents to the automobile dealer, and then a little later to the jobbing trade, and quite a business was built up.

But, the time soon arrived when we desired to enter the manufacturing field, and with this came the requirements that we make a pump that was not only good but would meet the price conditions that we had not met with up to that time.

Several Views of the Manufacturing Departments Where Oxy-Acetylene Welding Is Keeping Pace with Expanding Production Needs.

However there was one manufacturer who required a pump with a brass barrel, and we developed a self-brazing method of brazing the brass barrel to a steel base, in which we used the oxy-acetylene welding torch to accomplish this result. And then came the development of the steel barreled pump to meet this price condition.

We then entered the manufacture of steel tubing. We bought sheet stock and sheared it, in the early stages, on a sheet metal shear. We put these strips through a tuber, forming it into a tube shape in more or less the regular manner that tubes might have been formed up to that time, and we then devised welding machines which had suitable rolls and adjustments, were power driven with an oxy-acetylene torch attached and the necessary adjustments for guiding and moving the torch.

The torch condition at this early stage did not give us tubing that was free from skips, blow throughs, and misses, but as time went along, the torches were supplied until the time arrived when this condition was practically ended. Further improvements were made in the welding machine and with them came the time when, with a few instructions, a girl could operate one of these machines, and give us a satisfactory tube.

This pump tubing required a weld that needed only a swedging operation which would straighten the tube, and mash down the wrinkles on the inside and outside. In the early stages, this was a double operation in which we used to handle a hardbar, the length of the whole tube and of such a diameter that it could be forced into the tube, and then passed between heavy rollers. The hardbar was withdrawn, and the tube passed through a swedging machine, sizing the diameter and making it straight.

We later developed a new method in which we supported a correct sized arbor in the center of the swedging die in the swedger, leaving only the clearance necessary between the arbor and the swedging dies for the double thickness of the sheet metal used in making the tubing, or the size to which we wanted to reduce the tubing—in case that we wanted to pull it down. This not only smoothed out the wrinkles on the inside and outside, but produced a tube that was straight in one operation. In fact, we got tubing that could hardly be told from seamless. This proved to be a very satisfactory operation, but the swedgers had to be larger than we had used previously.

Then came the time that we looked for an increase in our tubing business, and we began the manufacture of such parts for washing machines and other household utilities. We then desired to enter the bent tubing field, making all types of exhaust and water tubing for the automobile manufacturers. About this same time, one of the large manufacturers just entering the field with a new car, came to us for a great deal of new development in the tubing necessary for the exhaust pipe and muffler tubes.

One tube required a flange that was about 30% larger than the original diameter of the tube. This gave us a welding problem in that the tube must stand this flanging operation as well as stand a small bend. The sheet metal had to have some characteristics that would stand this flanging, bending, and welding. Another interesting development in this flanging operation was the devising of a method that would heat the end of the tube approximately ⅜-in. back to a temperature that was a correct temperature for flanging. If the tube were heated too hot, the metal would break at some point other than at the weld, and if the temperature was too cold, the weld would break. So, it was necessary to keep a temperature between these two points. This flange was not only thrown out at an angle of 45° but was thinned at the edge at the same time. The machine made for heating the end of the tube was made so that the end of the tube would roll over. A number of oxy-acetylene torch tips were so placed as to give proper results. This new method proved to be a saving over our original outfit which was a special oil furnace with a heavy cast iron plate, and with holes only large enough to slip the tube in and out easily. This old method was expensive, but was not as dependable in that we could not get the same heating results

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on tubing placed in the various parts of the flame, and in addition the tubes themselves would be hotter at some places than in others.

In developing bending machinery, we worked out some equipment of our own which gave us a production which ran eight and ten times greater than we would have been able to get with any standard bending machine on the market. This, however, meant that we were subjecting the tubing and welds to far greater strain in forming and bending than we might have subjected the tubing to had we used the older method. Then we went still further in the development of other tools for making some of the larger bends in punch presses which ran this up still further, and still gave us further problems as far as metal forming was concerned, and, at the same time, put somewhat greater strains on the welds. These bending operations were very interesting because it is generally conceded that any forming operation which is particularly difficult should have a longer space of time so that it gives the metal less difficulty in forming.

The tubing manufacture requires our greatest use of carbide and oxygen, which amounts to approximately 700,000 cubic feet of oxygen and some 77 tons of carbide per month. Our tubing production runs to some 80,000 feet per day. We are able to get around 9 feet, 22 gauge tubing, per minute up to 2 feet per minute on 14 gauge tubing.

The oxy-acetylene process was further used in the development of a semi-automatic machine in which we brazed the steel pump tube to a steel base in which we are able to ge a production of some 3,000 pumps per day, per machine.

A still further use of the oxy-acetylene process came when we began to manufacture the well-known Arvin Hot Water Heaters. This requires some brazing, but we depended on oxy-acetylene torches to accomplish our most intricate soldering work—namely, the attaching of the tanks to the headers on the cores, this being a lap joint. The headers and the tanks fit very close together which requires that the solder be run in between the metal, rather than a joint made just at the edge of the header, with the use of a soldering iron.

The use of such large quantities of oxygen and carbide makes it highly important that we look into and try every suggestion and scheme in the oxy-acetylene process which will give us still further economy. There is an extremely large opportunity for engineering developments in torches and torch methods that may be applied to the welding of tubing. This particular field is large.

Developments along most lines are toward sheet metal products, and tubing plays a large part in the make-up of articles, as produced today, as against what we were familiar with a few years past.

While we go to great lengths in the developments and devising of schemes and means of making sheet metal working tools, dies, and such, we depend on the oxy-acetylene industry to develop new means and methods necessary to accomplish further economies in welding.

Another Construction Problem Solved By Arc Welding

Since 1926, when arc welding started stepping high and wide into manufacturing and construction fields, it has blazed many a trail of achievements. It has taken the kinks out of production lines, shortened delivery hours, made possible economies in construction, improved products and even made possible the solving of manufacturing and construction design problems.

Without arc welding it would have been impractical to build the Westinghouse outdoor substation housings recently completed at East Pittsburgh. These large structures—the first of their kind—will each house a 21,400 kv-a. Westinghouse frequency changer set for railroad electrification near Philadelphia. Completely assembled in the shop, they measure 65 feet long, 25 ft. 10 in. wide and 15 ft. 4½ in. high. They were disassembled for shipment into five lower sections and eight upper. The structure weighs approximately 110,000 pounds.

More than one and a half miles of arc welding beads join the steel parts of the massive structure. It is fabricated from quarter-inch rolled steel plate, securely supported by ribs made of I-beams, channel pieces, angle iron and plate material. Figure 1 illustrates a typical interior section showing the flexible design of the supporting ribs made possible by arc welding. A compartment, built into each end of the housing contains an oil filter for cleaning the ventilating air for the huge electrical machine. Air comes in on one side through a louvre. Exhaust air passes out on the other side. A shutter arrangement is provided between the two sides, so that snow, entering with the fresh air and tending to clog the oil filter, may be melted by letting the warm exhaust air into that side. Four-I beams, included within the structure, will each carry a hand operated hoist for handling the bearing caps of the machine. All of these and many more fixtures—even the self-closing housing doors—are of arc welded construction.

Left, Interior of Typical Section. Center, Welded Door Construction. Right, Exterior View of Completed Section.

Arc Welding of Aluminum*

Use of Flux Coated Electrode of Correct Analysis and Proper Manipulation Are Indicated as Important Elements of Success

By W. M. Dunlap†

FUSION welding has been divided into two general classes: torch welding and arc welding. The fusion welding of aluminum and its alloys by means of an oxy-hydrogen or oxy-acetylene torch is an art that has been known and practiced for the past fifteen or twenty years by metal workers engaged in the fabrication of aluminum articles. During the past year much information concerning the torch and spot welding of aluminum and its alloys has been published in the various technical journals. However, insofar as the author has been able to determine, there has been nothing published concerning the arc welding of the above metals. The consensus of opinion seems to be that aluminum cannot be arc welded. This opinion was entirely correct until a very few months ago. During the past few months rather extensive investigations of the application of the arc welding process to aluminum have been conducted in the Aluminum Research Laboratories of the Aluminum Company of America under the supervision of the author. As a result of this work, the process has been developed to the point where, within certain limits, it may be considered practical as a production method. At the present time the successful commercial arc welding of aluminum and its alloys is being done by several metal fabricating plants.

The arc welding process is divided into two classes: Metallic arc, or Slavianoff process and carbon arc, or Bernardos process. Both of these methods are coming into use for welding aluminum; however, the former process only will be discussed in this paper.

Electric arc welding dates back to about 1881 and the general principles of the process are well known. This paper will discuss the application of these principles to the welding of aluminum. The first principle involved in this case consists chiefly in the heating of the work to a welding temperature by means of an electric arc produced or "struck" between the work and a metallic electrode. The electrode melts and feeds into the joint, thus supplying the material required to complete the weld. The arc serves three distinct purposes: it supplies heat to melt the edges of the joint, heat to melt the electrode metal, and it carries the metal from the electrode to the weld. The electrode serves two purposes: it constitutes a portion of the electrical circuit, and is a source of filler metal for the weld.

Equipment Used for Arc Welding Aluminum

The equipment required for arc welding aluminum is practically the same as that used for similar work on other metals and consists of: a welding generator, a pair of lead cables, an electrode holder, a ground clamp, an operator's helmet or shield, and a supply of electrodes.

The generator should be a variable voltage machine with a current rating of from 50 to 200 or 300 amp. and an open circuit (striking) voltage of about 60 volts. It may have any one of the common types of drive—electric motor, gasoline motor, or belt—but for a small single operator unit it will be found more practicable to have a portable motor-generator set. It will be found best to secure a machine which the manufacturer has designated to hold a stable arc at low currents, and in addition, it is suggested that a stabilizing resistance be secured with the machine if it is to be used on light work.

The machine used in the experimental work was a portable welder of the variable voltage type. It has a current rating of from 50 to 300 amp. with a striking voltage of 50 to 60 volts. The machine was driven by an induction motor and was of two-bearing construction—motor rotor and generator armature on a common shaft.

Electrodes Suited for the Process

Experience in torch welding has shown that only two types of wire are required in welding sheet aluminum. For work on 2S or 3S, a pure aluminum (2S) wire is used, while when welding the strong alloys (17S, 25S, 51S) it is advisable to use a 5 per cent silicon, 95 per cent aluminum wire, especially when the work is not free to contract on cooling.

Figure 1. The Operator Is Holding the Electrode at the Proper Angle. A Series of Flux Coated Electrodes Is Shown in the Foreground.

The strong alloys are all somewhat "hot short" and all have a high co-efficient of expansion. Furthermore, they all melt at temperatures less than that of 2S. Therefore if a 2S electrode is used, the added metal in the weld will solidify before the metal of the sheet. This places the contraction strains in the alloy sheet at a time when that metal, because of its high temperature is quite weak. This is likely to cause the for-

*Paper presented at Fall Meeting, A.W.S., Chicago, Ill., September, 1930.

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mation of cracks adjacent to the weld, especially if the metal is clamped in a jig.

When the 5 per cent silicon electrode is used this cracking is eliminated. This alloy melts at a temperature slightly below the strong alloy and is noted for its hot strength and slight solidification contraction. Because of these characteristics, the added metal in the weld acts similarly to the gate in a casting. This action places the contraction stresses in the weld metal where the hot strength is sufficient to prevent cracks.

It is often suggested that a filler rod (electrode) of the same composition as the sheet be used in welding strong

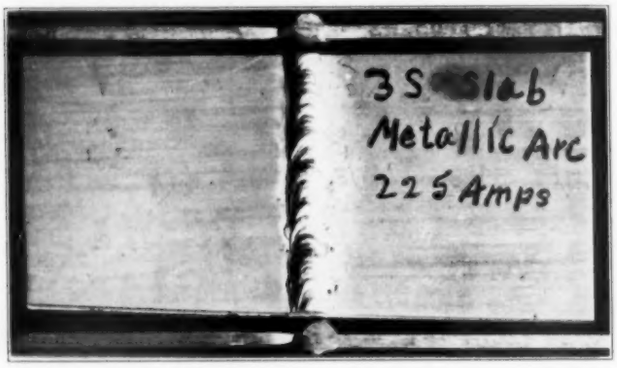


Figure 2. Specimen Weld Made in $\frac{3}{8}$-in. Aluminum Plate.

alloys and castings. When welding castings this procedure will often be found satisfactory, or even advisable, but the 5 per cent silicon electrode will prove the most useful for welding the wrought strong alloys.

The electrodes are of the flux-coated type. In fact, the whole secret of successfully arc welding aluminum and its alloys depends upon the use of a proper flux. It has been found that a ⅛ in. diameter electrode will prove satisfactory for practically all gages up to ¼ in., provided that the operator varies his technique to suit the thickness of the metal. Since the flux coating is an insulator, it is necessary to limit the electrode length to such that when it is gripped at one end by the electrode holder, it will not be unwieldy. Experience has shown that an electrode about 15 in. long and coated to within 1 in. to 1½ in. of one end is quite satisfactory.

A Good Flux Must Be Used

The torch welding of aluminum was never a real success until a suitable and satisfactory flux was developed. Now that the flux method of welding this metal has become standard practice with the artificers, the torch welding of aluminum has reached a state of perfection. Just as a proper flux is essential for successful torch welding, so it is for arc welding. The experimental work quickly showed that a bare electrode would not prove satisfactory for arc welding aluminum, so investigations were begun to develop a satisfactory flux. This flux must serve the same purpose in arc welding that it does in torch welding. In addition, it must decrease the surface tension of the aluminum so that the molten metal will flow smoothly from the end of the electrode without the formation of drops; the flux should also aid in stabilizing the arc. In order to fulfill the above requirements, the flux should have the following characteristics:

1. It must melt at a temperature just below that of aluminum.

2. When molten, it must have the ability to remove aluminum oxide and do it very quickly.

3. The molten flux, containing the oxide must have a specific gravity less than that of the molten aluminum, and the difference must be enough that the flux will quickly and rapidly come to the surface of the molten metal, thus removing the oxide. This is particularly important in arc welding as the weld metal solidifies very rapidly.

4. The flux must be stable under the temperatures employed. For arc welding, this stability is of greater importance than for torch welding.

5. It must not deteriorate with time, nor must it be too deliquescent.

6. When dried on the electrode the flux must bind together well.

7. The molten flux must lower the surface tension of the molten aluminum so as to prevent the formation of drops on the end of the electrode as it melts.

A flux meeting the above requirements was finally developed by the author and is now being sold by the Aluminum Company of America, under the trade name of No. 25 Arc Welding Flux.

For coating the electrodes the flux is mixed with water to the consistency of thick paint and the wires are dipped in this paste. The excess flux is allowed to drain off and the rods are then dried. The flux coating on the metallic arc welding electrodes should be approximately 0.025 to 0.03 in. thick. To secure this thickness, it has been found advisable to dip the rods two times, thoroughly drying the first coating before the second one is applied. After a little experience the man coating the rods can judge the proper flux consistency to use, so that dipping twice will produce the desired flux thickness.

The dipping tube or trough should be made from aluminum or brass. Iron should be avoided, as the chemical action of the flux on that metal will cause contamination.

The rods should be dried in a current of warm air (about 60 deg. C.), or in a ventilated drying oven at about 65 deg. C. The drying will, of course, be rather slow at these temperatures, but if a higher drying temperature is used, the steam formed will cause the flux to crack and peel off.

Proper Characteristics of the Arc

The exceedingly high temperature of the arc, together with the short flame, is an important factor in developing the improved physical properties of arc welds as compared with torch welds. The high temperature produces rapid fusion in the work and the electrode, while the short arc localizes the heat. These properties greatly reduce the width of the heat affected area in the sheet, with a corresponding increase in weld efficiency. These same factors, combined with the rapid heat fluctuations, operate to the disadvantage of the process, since they set the lower limit in the range of work.

The metallic arc, furthermore, is almost inherently unstable for several reasons. One reason is that the filler metal must pass through the arc during the welding operation. Then, too, the normal tendency of the arc is to "pull off" a cold spot in preference to a hot one, and this leads to an unstable condition.

The flux coating on the rods is the primary stabilizing agent of the process. This flux must serve three important functions. It should furnish an insulating sheath around the arc, produce arc vapor with good conductivity, and reduce the surface tension of the molten electrode metal so that it will pass through the arc in small globules rather than in large drops.

A further aid in stabilizing the arc is the use of a short arc-length. This is entirely a mechanical factor, but in the experimental work the flux coating on the rods was designed to offer some aid. This was done by making the coating such that it did not melt as rapidly as the rod. That action produces a sheath of such length at the end of the rod that the operator can have the end of this sheath in contact with the work and, at the same time, have a satisfactory arc length.

As the currents used in arc-welding aluminum usually fall in the lower range of the smallest available welding gener-

tors, it will usually be found that the machine does not hold a stable arc. To correct this difficulty, a stabilizer consisting of about a half ohm resistance can be connected in series with the arc.

In welding aluminum with the metallic arc, only one polarity is required, regardless of the alloy being welded or the thickness of the work. This polarity is with the electrode positive and the work negative, or what is commonly called "reversed polarity."

The primary reason for using this polarity is to improve the arc stability. It does this by permitting the use of higher currents (since the major portion of the heat is at the positive terminal), which, in turn, permit a heavier flux coating. Furthermore, the increase in current, in itself, improves stability.

Preparation of the Sheets

Preparation of the edges is not required on sheets up to ⅛ in. thickness as the metallic arc will produce complete penetration when the edges are merely butted together. Material thicker than ⅛ in. however, should have the edges beveled to form a 90 deg. vee. This vee should not extend completely through the plate, but about an eighth-inch lip should remain. This lip may be notched with a chisel as in torch welding, but that is not necessary. If it is done, the notches should be about 1/16 in. to ⅛ in. deep and about ¼ in. apart.

Properly Designed Jigs Should Be Used

It is advisable to have some type of jig to hold the work in line when doing metallic arc welding. The jig, however, need not be as rigid as one used for torch welding, as less buckling accompanies metallic arc welding. In all work where it is possible, the seam should be backed up with a copper or iron backing strip—preferably the former. This is advisable because the metal in the "puddle" is quite fluid and, unless some support is given, the action of the arc will blow holes in the weld, or penetration will be excessive. If the backing strip is flat on its entire surface, however, the under side of the weld will be found to be slightly concave, because of contraction on cooling. To avoid this trouble, the backing strip should be made with a slight clearance directly under the seam. Cutting a shallow groove in the backing plate, or, in the case of an angle used to back up a corner weld, grinding off the edge, will produce the desired clearance. Almost any suitable type of clamp or weight can be used to hold the work in place during welding.

In placing the work in the jig, it has been found that no spacing is required. Of course this conclusion is drawn from experimental work and is based on experience with comparatively short seams. Production work on long seams may dictate some changes in this technique.

How the Electrode Should Be Manipulated

It has been found that the most satisfactory method of "striking" the arc is to brush the end of the electrode across the work in a manner similar to lighting a match. The electrode metal melts very rapidly in the arc and, likewise, solidifies quite rapidly when the arc is extinguished. For this reason, it will be found that an attempt to draw the arc by touching the rod to the work will, almost invariably, result in "burning fast" or "freezing" the rod to the work.

The arc may be struck directly on the seam or on the jig near the edge of the work. It should be struck near the point where welding is to start, so that progress along the seam can be immediately begun. If much movement of the electrode is required after the arc has been first struck, it may "blow out." Quite often this results in the formation of a fused-flux coating over the end of the rod which interferes with re-establishing the arc.

Movement along the seam may be in either a forward or backward direction, as the operator desires or the work dictates. The movement, however, should be at a uniform rate so that an even bead is made. To secure the best results, the electrode should be held approximately vertical at all times. It has been found, however, that slanting the electrode slightly (not over 20 deg. from the vertical) will sometimes prove satisfactory, and will be more convenient to the operator. If this is done, the electrode should point away from the direction of motion.

The arc should always be kept as short as possible, in order to improve its stability. An arc length of ⅛ in. to 3/16 in. is the most satisfactory, and it should never exceed ¼ in. When a long arc is used, the arc "waves" excessively, small globules of semi-molten metal are thrown about, and the arc is hard to maintain. Proper thickness of the flux coating on the electrodes is a great aid in maintaining a uniform arc length. When the electrodes are coated as previously described, it will be found that the flux coating will melt a little more slowly than the metal in the rod. This action produces a flux sheath around the arc which, in addition to stabilizing the arc and limiting its "play," serves as a guide for arc length.

A detailed description of arc manipulation is practically impossible, for, as anyone familiar with arc welding knows, much of the technique depends on the operator's "feel." After a little practice, the operator will find that the arc welding of aluminum is a very simple process. There is no weaving of the electrode as in steel welding. The electrode is advanced in a straight line along the seam. In the case of heavy plate, the electrode is moved forward and backward to build up a bead of the desired height; the electrode is never moved back and forth across the weld.

The most practical use of the metallic arc for aluminum welding is in making a straight butt weld or a corner weld. For these applications, the method has been found quite satisfactory for all of the aluminum alloys. The use of the metallic arc for tee and lap welds has not been very extensively investigated, but what work has been done indicates fair results.

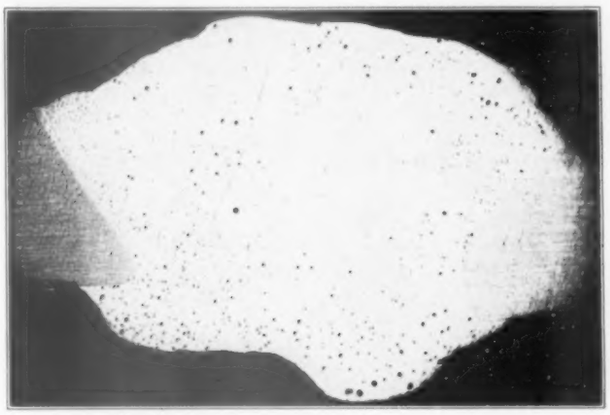


Figure 3. A Cross-Section of the Weld Shown in Figure 2.

The metallic arc can be used for welding aluminum sheet No. 14 B.S. gage and heavier. An upper limit has not been set, as this limit depends more upon the results desired than on the possibilities of the process. The heaviest material used experimentally was ⅜-in. sheet, and the welds were very satisfactory.

Why the Arc Will Burn Through Thin Gage Sheets

The lower limit can rather definitely be placed at No. 14 gage as it has been found that lighter material will burn through with the minimum current that can be used. This trouble appears to be an inherent characteristic of the metallic arc. It is chiefly due to the fact that the minimum current which will maintain a stable arc is rather high.

The theory has been advanced by J. B. Green of the Fusion Welding Corporation that the variation of the heat, caused by metal passing from the electrode to the work, is the cause

of the trouble. This theory is: As the metal drop which has been formed on the end of the electrode passes to the work and momentarily extinguishes the arc, the heat is varied from maximum to zero. As the arc is re-established after the passage of the drop, the heat again rises to the maximum. It is suggested that this great heat variation is the factor which makes the use of the metallic arc on light sheet impossible.

A Few Difficulties Which Beset the Operator

There are only a few difficulties that the operator will encounter when arc welding aluminum, and most of these can be attributed to technique. One difficulty which is peculiar

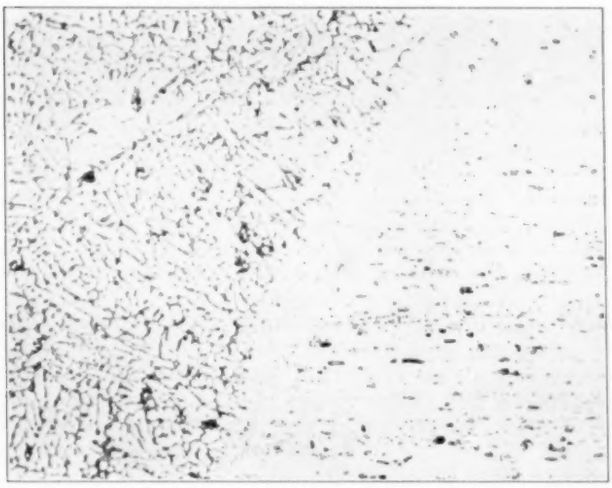


Figure 4. Photomicrograph Indicating Transition Zone of Weld Section Shown in Figure 3.
The Cast Structure of Weld Proper is Shown on the Left, the Transition Zone in the Center and the Wrought Structure of the Base Metal on the Right.

to this process is the formation of the insulating, fused-flux coating over the tip of the electrode when the arc "blows out." This characteristic is rather annoying and is a source of time loss, but otherwise is not very important. To re-establish the arc, it is necessary to tap the end of the electrode on the work until the coating cracks off, or to clip the end of the rod off with a pair of pliers.

Moving along the seam too slowly results in burning holes or in developing an excessive bead, while moving too rapidly results in poor penetration. Using too high a current will result in "burned" work, and too low a current results in little or no penetration.

The most outstanding advantage in the use of metallic arc welding is in its cheapness; the operating speed of this method is greater than for any other fusion welding process. Where applicable, the arc welding process is cheaper than the oxy-hydrogen or oxy-acetylene welding process. This saving is in the difference in the cost of gas as compared with the cost for electrical power and in the difference in labor cost. The first cost of the arc welding process will probably be greater, especially for small installations, while the cost of electrodes will be somewhat more than for filler wire and flux in torch welding. The decreased operating costs, however, will soon show a saving.

The metallic arc welding process is particularly applicable to certain classes of work such as the reclamation of defective castings in foundries, repairing broken castings, architectural shapes, etc. There is less buckling and warping of the work when arc welding than when torch welding, and preheating before welding can be largely eliminated. The temper of the sheet is less affected during arc welding than during torch welding, as in the former case the heat is much more concentrated and localized and the weld is made much more quickly.

The flux used in arc welding, like that for torch welding, is corrosive and must be removed after welding is completed. The most satisfactory method to remove this flux is to soak the weld in hot 5 per cent nitric acid or warm 10 per cent sulphuric acid solution for a short time and then to rinse it in hot water. Soaking in hot water, at the same time scrubbing the weld with a stiff brush, is also quite satisfactory. The weld may be cleaned by impinging a steam jet on it. This method has advantages for removing the flux from corners.

After the flux has been removed, the weld can be finished by chipping off the excess metal with a pneumatic chisel and then hammering the weld with an automatic hammer. Care should be taken that the hammering does not start small cracks that will reduce the strength. Another method of finishing is to grind off the excess weld metal and then polish the work on a buffing wheel. This method is to be preferred where a good finish is desired. A good weld finished in this manner cannot usually be detected.

Welded Floating Decks Save Weight and Cost

By employing welded construction, the Columbian Steel Tank Co., of Kansas City, Mo., are incorporating several desirable features in the floating decks they are making for small vertical tanks to be used in storing refined gasoline.

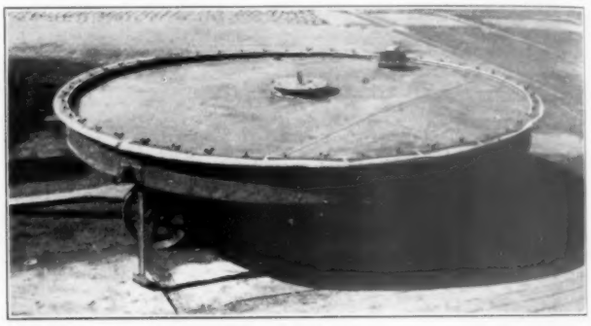


Figure 1. Each Welded Floating Deck is Given a Thorough Test Before Shipment.

The company developed this style of deck only during the past month. The deck, which is of all-welded construction, is light in weight and inexpensive and is equipped with a new balanced thief hole in which Columbian engineers have embodied some novel and desirable features.

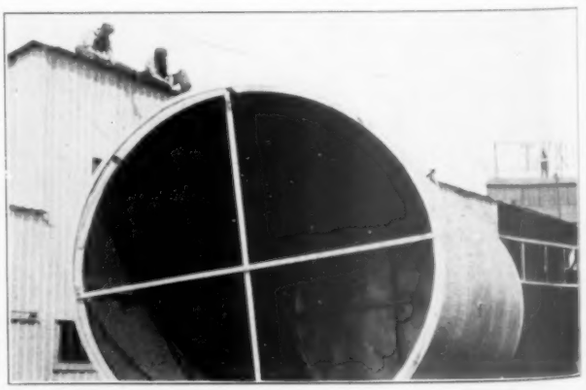


Figure 2. A 20,000 Gallon Tank Ready for Shipment.

The deck, which is shown in Fig. 1, is given a pressure test to determine any leaks before being sent out. Edges of asbestos canvass raised about an inch above the platform level effect a compact lid which prevents the formation of inflammable vapors from refined gasoline by eliminating the air space between the deck and the liquid. The deck is 11 ft. in diameter and was built for the 20,000-gal. tank shown in Fig. 2, and is shipped inside the tank as shown.

Fifth Annual Welding Conference at North Texas A. C.

Plans have been completed for the Fifth Annual Welding Conference, which will be held at North Texas Agricultural College, Arlington, Texas, April 22nd and 23rd, under the direction of the Engineering and Trades Department. Meetings and demonstrations will be held in the Mechanical Arts Building. The papers to be read in the course of the two-day program are:

"Possibilities in the Welding Industry for Those Who Have Been Adequately Trained," by L. C. Monroe, Assistant Editor, The Welding Engineer Publishing Co., Chicago, Ill.

"Arc Welding, the Modern Putting On Tool," by K. L. Hansen, The K. L. Hansen Engineering Company, Milwaukee, Wis.

"Welding on the Dallas Power & Light Building, the Highest Arc Welded Building Ever Built," by M. M. Stetler, Mosher Steel & Machinery Company, Dallas, Texas.

Paper, by L. A. Hamilton, Magnolia Airco Gas Products Company.

"Copper, Brass and Bronze in the Welding Shop," by W. C. Swift, American Brass Company, Kenosha, Wisconsin.

"Lindeweld Process," by Linde Air Products Company, Dallas, Texas.

"Arc Welding Processes," by Big Three Welding Company, Fort Worth, Texas.

These papers will be supplemented by the showing of motion pictures, discussions and question periods. The following exhibiting companies are listed in the program: American Brass Co., Big Three Welding Equipment Co., Burdett Oxygen Co., Ferris Tractor Company, Fort Worth Well Machinery Company, General Electric Co., Hansen Arc Welders, Hollup Arc Welders, Lincoln Arc Welders, Linde Air Products Co., Magnolia Airco Gas Products Co., Milburn Equipment, Modern Engineering Co., Owen Electric Co., Ranger Generator Co., Rego Equipment Corp., Smith Welding Equipment Corp., Southern Supply Co., Stellite Co., Supreme Generator Co., United States Arc Welders, Welders Supply Co., Wichita Falls Oxygen Co., Wilco Arc Welders.

The purpose of the conference is to extend the services of the college by bringing together a group of men who are interested in the latest developments and possibilities of welding. No registration fee is charged, and a cordial welcome has been extended to all users of welding equipment to attend this conference. This has become an annual affair in the North Texas District, and the continued interest shown in the program is good evidence that these meetings have become recognized as a constructive influence in that territory.

Much credit is due to M. C. Stone, Head of Engineering and Trades Dept., in arranging this meeting.

One Day Welding Symposium Held at Lehigh

A full day's program, comprised of morning, afternoon and evening sessions, attracted a number of welders, supervisors and engineers to the welding symposium held at Lehigh University, Bethlehem, Pa., on Friday, March 27.

At the morning session, Prof. Comfort A. Adams, Director of the American Bureau of Welding, read a paper on the subject of "Welding Engineering". Other papers in the forenoon session were "Examination of Welds by Gamma Rays" by Prof. Gilbert E. Doan of Lehigh University; "Shop and Field Welding of Dallas Power and Light Company's Office Building at Dallas, Texas," by William F. Carson, Structural Engineer, and "The Welding of Aluminum," by John J. Bowman of the Aluminum Company of America. Dr. Charles R. Richards, President of Lehigh University, presided at this session.

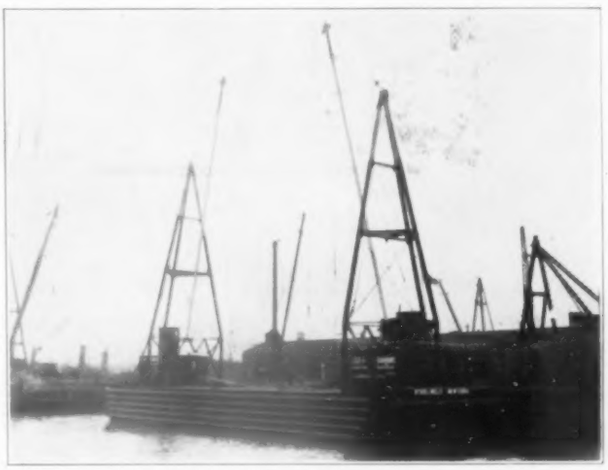
There were no papers read at the afternoon session. In one laboratory there were held demonstrations of examination of metals by gamma rays; testing welds, butt welding, gas welding, thermit welding, atomic hydrogen welding, oxygen cutting, mechanical cutting and the welding of alloy steels. In another laboratory there were demonstrations of arc welding and the mechanical testing of welded coupons. In a third laboratory there were demonstrations of automatic arc welding and spot welding. A number of motion pictures on welding subjects were available for the afternoon session, each picture being shown in a separate room.

At the evening session, the following papers were read: "The Qualities of Arc Weld Metal" by J. C. Hodge of The Babcock & Wilcox Company; "Battledeck Construction," by Lee H. Miller, Chief Engineer, American Institute of Steel Construction and "The Shielded Arc," by J. F. Lincoln of the Lincoln Electric Company.

Additions Made to "Steelweld" Steel Barge

After more than a year's operation, under severe conditions, of their first 1000-ton all welded steel barge, the Lee & Simmons Company has found it so satisfactory as to warrant further investment by fitting up this barge with steel sheer legs at each end, some 65 feet high, and rigged with 75-foot booms.

An additional house has been built at the forward end and both houses have a small control room on top where the operator handles the booms by way of gasoline driven hoisting engines placed below.



All-Welded Sheer Legs Added to the Barge "Steelweld."

Power driven pumps have been installed that may see little service, as so far the bilges have been perfectly dry and original pumps have never been used. However, collision damage might provide excellent use for these power pumps, connected as they are to each of the five watertight compartments.

The heavy deck and side plating with the five special formed fenders on each side have stood up so well that the barge today looks as if it had just left the yard of its builder, the Electric Boat Company of Groton, Conn.

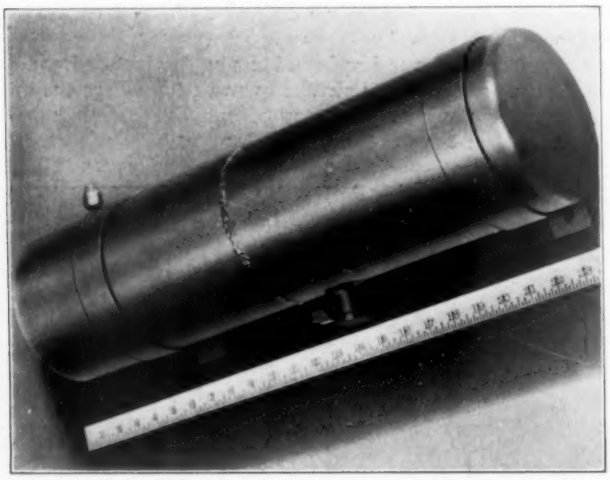
The designer of this barge, E. H. Ewertz, 26 Cortlandt Street, New York, who by the use of his patents has produced such a fine hull construction, is pleased with the results; but the matter of most interest is that a deck barge 118 feet long by 36-foot beam by 11 feet deep, capable of carrying a 1000-ton deck load, can be built of 165 tons of steel, primarily plates, with only some 18,000 feet of welding, and made to stand up satisfactorily under the severe operating conditions in the New York harbor.

Hints for the Welder

WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.

Has It Ever Occurred To You?

The above apt phrase is the heading for an advertisement of the Detroit Metal Specialty Corp., makers of Metalbilt Products. The text goes on to point out that those manufacturers of tanks who are welding two ends to a length of tubing are performing an extra operation and are incurring one extra seam with a possibility of leaks. The illustration which accompanies the text is reproduced herewith. The two deep drawn shells are joined together with only one weld in the center—clearly a saving of time and money in the fabrication process and where finish grinding is necessary for appearance of the product another operation is eliminated.



Has It Ever Occurred to You to Study Further Simplification of Weld Design?

How to Boost the Welding Business in a Country Town

By J. K. Rodgers

The right way to build up a profitable welding business in a country town shop is to advertise a complete welding service for prospective patrons, then turn out the kind of work which creates goodwill and results in favorable word-of-mouth advertising by pleased patrons. Briefly, this is how Mr. B. E. Dalrymple, proprietor of the Quick Service Welding Company, Marysville, Kansas, developed his business in this town of 4,000 population.

Locating in Marysville during the autumn of 1929, Mr. Dalrymple immediately engaged in the welding business, his first location being in a garage. His business grew so rapidly that he found it advisable to move to a larger shop, where he would have ample space to give his patrons efficient service. His shop is fully equipped for both electric arc and oxy-acetylene welding.

A large portion of his business comes from the rural territory surrounding Marysville. He finds farmers are good patrons, provided pains are taken to inform them regarding the economy and all around desirability of a modern welding service for repairing broken castings on farm machinery, building up broken or worn gear teeth on machinery, tractor and auto repair work, etc. He uses illustrated newspaper ads for giving farmers, and other prospective patrons, specific information regarding his capable welding service; he finds this is a successful method for bringing in new business. He secures best results from ads, which through picture and story, give prospective patrons live ideas regarding their need of his welding service.

Welding That Lasts!
both
Electric Arc
and
Ox-Acetylene
Now is the time to check your farm machinery for broken castings, avoiding the spring and harvest rushes. Gear teeth of farm machinery built up like new.
In fact we weld and braze anything that can be amalgamated.
Remember if you have a motor head that has been frozen and cracked I can save you many dollars by repairing it. The motor need not be removed from the frame.
Why neglect your fenders when they can be welded like new? Also see us about repairing your radiator.
Quick Service Welding Co.
Phone 670
705 Elm Street

Advertisements of This Calibre Build Business.

A Quick Method of Preheating

By M. Banke

Possibly some job shop welders and welders in maintenance departments of mills and factories will be interested in what the writer calls "The Sunburst" method of preheating metals quickly. As applied in our shop, this method is used for heating steels, for bending or straightening, such as the straightening of heavy automobile frames. We first heat the thinnest place, using the tip of the cone of the neutral flame. When the red heat is reached, we draw away the torch gradually. At the same time we turn on both valves of the torch to the limit of its capacity. When the gases strike the hot steel, a flaring fire against the surface of the steel is produced, which we call "The Sunburst". As the steel becomes heated, we direct the torch toward the heavier section. This sort of flame seems to be equal to half-a-dozen neutral flames for preheat and greatly speeds up the work. Furthermore, heavy sections can be handled with a single torch and the operator remains in a comfortable position reasonably far from the heat.

Total of Bronze Welded Repair Costs 20% of New Part

This surprising economy was accomplished by a coal company in western Pennsylvania says an article in a recent issue of *Oxy-Acetylene Tips*. Due to accidental overloading a 17,500 lb. hoisting engine bed was badly fractured. The front end was broken off and the crosshead bearing badly cracked.

The fractured bed was brought to the repair shop where mechanics lined it up for the bronze welding operation. The cast iron along the line of break was chipped out with a pneumatic chipping hammer as shown in Figure 2. Then, on account of the size of the casting it was thought best to preheat it, the general arrangement of the preheating furnace being shown in Figure 2.

After two hours of preheating, three operators started applying the bronze. Sections of the vee were heated two inches at a time until they were hot enough for the tinning operation which was followed by completely filling the vee with bronze to the full depth of the fracture, which varied from 1¼ in. to 5 in.

The three operators completed the 28-foot fracture in only 18 hours actual welding time. The complete job required about 215 pounds of bronze welding rod. On completion the casting was allowed to cool slowly after which the necessary machining was done on the crosshead bearing and then returned to service where it has proved entirely satisfactory in operation.

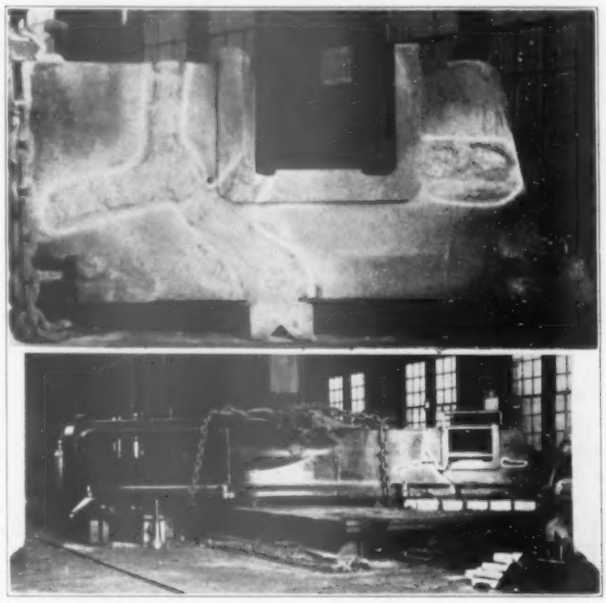


Figure 1. (Above) The Finished Bronze Weld in the Engine Bed.
Figure 2. (Below) The Fracture Chipped Out and the Base of the Preheating Furnace.

The total cost of this repair including oxygen, acetylene, welding rod, flux, charcoal, asbestos paper, labor in repairing, welding and machining and overhead amounted to only 20 per cent of the replacement cost of the casting.

Building a Job Welding Business

By W. Irving Brockson

II.—Salesmanship— The Key to Success

THE success of any job welding business depends more upon salesmanship than any other factor. Given two welding shops of equal equipment, location, welding skill and everything else except ability to sell, and the one proficient in this respect will by far outdistance the other.

What Is Salesmanship?

By salesmanship in this sense is meant the ability (a) to locate prospective jobs for the business; (b) to make a favorable impression upon the foreman, superintendent or owner, who may have welding business to place; (c) not only to make a favorable impression, but also to "close" the order—get the name on the "dotted line," and (d) to make every job a stepping stone to a repeat order or to a job with another concern.

An Aggressive Policy Essential to Success

The manager of a job welding shop should thoroughly understand that an aggressive policy is the only one that will ever build a business. Too many shop managers follow the "watchful waiting" plan and sit around expecting business to come their way, rather than going out after it. Other shop owners rely upon their up-to-the-minute equipment, their masterful skill with the torch or with the arc and their long years of experience to bring them work. These are necessary, to be sure, but they alone will never build a business; customers and prospects must know about them and be persuaded to make use of them before they count for anything on the profit side of the ledger.

"Mouse Trap" Theory Exploded

There used to be a theory, credited by some to Emerson and by others to Elbert Hubbard, that "If a man makes a better mouse trap, the world will beat a pathway to his door, even though he live in the heart of a wilderness." Modern business has, time and time again, shown the fallacy of that theory. Most assuredly, the mouse trap—or the "welding service," if you please—must be good, but unless it is coupled with sound, aggressive salesmanship, it

will remain forever in the heart of the wilderness of business obscurity.

The Tools of Good Salesmanship

There are numerous ways in which this policy of aggressive salesmanship may be put into practice at the beginning of the business and later. Some of these ways are: (1) large, legible signs on the building made by a professional sign painter and not "home painted"; (2) road and street signs placed at strategic points; (3) listing the firm name both in the alphabetical and the classified sections of the local telephone directory; (4) judicious use of circulars or printed matter mailed to logical prospects; (5) in some cases, occasional advertising in the local newspaper; (6) telephone calls to acquaintances and other prospects to whom a specific proposal for a job can be prepared; (7) personal calls on prospects. The shop is rare that could not employ all of these methods to advantage, yet how many are actually doing it? Each of these points will be discussed in more detail in later installments of this series.

Developing Welding Jobs

One of the most difficult things for the average shop to do is to create jobs for welding. Nevertheless, this offers a tremendous field and is one of the most effective ways thoroughly to sell a customer and to cinch repeat orders. By thinking back over his experience, every welder can recall numerous cases where welding has profitably replaced other processes or where it has reclaimed equipment of a certain type slated for the junk pile. Where such a job has been done with one firm, as many concerns as possible of a similar character should be sought out and approached on the same sort of job. Let your prospects know that you are reducing operating costs for their competitors.

Keeping Step with the Welding Industry

Welding is one of the fastest growing industries in the country. Gas, electric, spot and automatic welding are being applied to more and more purposes every day. The wide awake welding shop will keep abreast of new developments in the industry and be the first in the community to apply them. The next step is to let people in the territory know that the shop has both the equipment and the skill to put every new development into practice.

The Customer's Point of View

In all activities of salesmanship and development, it is essential to work from the customer's point of view. No one is going to give a shop business simply because that shop wants it. The most important thing in the world to the customer is the customer—his plant, his machinery, his product, his profits. To be successful the welding shop manager must talk and act in these terms—get over on the customer's "side of the fence" and show him where he can cut his losses by reclaiming certain equipment or reduce his costs of production by the use of a specific welding operation. Study the prospect's business and his methods and show him where he can profit by the use of Job Welding Service. This is the most important part of "selling the service." Aggressiveness in selling and advertising does not mean *boasting*. It means getting out of the shop and getting into places where business may be found and "finding your man," and showing him things he didn't know about saving money by patronizing your shop.

Obituary: Edmond Fouche

We have learned with great sorrow that M. Edmond Fouche died suddenly at his home in Paris, on February 24th.

M. Fouche was president of the Chambre Syndicale de l'Acètyléne et de la Soudure Autogène from 1922. He was chairman of the Eighth International Congress for Acetylene and Autogeneous Welding, which took place at Paris in December 1923. Some months after he was elected president of the Permanent International Commission for Acetylene and Autogenous Welding, which has been created following this Congress. He had been uninterruptedly reelected, and this same year had been nominated as president for life by the members of the Permanent International Commission.

M. Fouche was also president of the Institut de Soudure Autogène and this charge conferred on him the presidency of the Managing Council of the Ecole Supérieure de Soudure Autogène of which he had agreed to be the first manager.

Edmond Fouche.

Moreover, M. Fouche took part from the beginning in the Managing Committee of the Office Central. He had been nominated as an honorary member by the American Welding Society and the British Acetylene Association and also of several other associations in foreign countries. In 1924 he was awarded the Morehead medal by the International Acetylene Association.

All these titles denote sufficiently the commanding personality of the deceased, as well as his great merits. His life was a model of labor and honor.

Former scholar at the Ecole des Arts et Métiers of Angeres, then of the Ecole Polytechnique, engineer at the Railways Company Paris-Lyon-Méditerrannée, then of different companies, he was chosen by the Compagnie Francaise de l' Acétylène Dissous, in 1896, to manage the studies and practical application of the systems developed by Claude and Hesse. In this work he had as partners Charles Picard and Armand Janet. He investigated all the possible uses of dissolved acetylene, and was particularly interested in the high temperature produced by mixtures of acetylene and oxygen. This led to the first oxy-acetylene blowpipe, working with acetylene under high pressure, conceived by Fouche and Picard.

Two years after, M. Fouche invented the blowpipe with acetylene under low pressure, which bore his name for a long time and bears it even now in numerous foreign countries; from it have been derived all the oxy-acetylene blowpipes now in use. This oxy-acetylene blowpipe for low pressures suggested to him the idea of the hydraulic valve which would hold up the backward flow of oxygen to the acetylene generators.

M. Fouche was the author of numerous investigations and memoirs, several of which having been presented to the Académie des Sciences (photometric studies; gas liquefaction; acetylene combustion, etc.). For many years he was vice-

president of the Association of Former Scholars of the Ecoles d'Arts et Métiers and member of the Committee of the Société des Ingenieurs Civils de France. He was engineer and department manager in the Compagnie de Fives-Lille for many years.

All those who have known the deceased appreciated the qualities of his spirit and heart, his high intelligence and the wisdom of his counsels. The progress of autogeneous welding is due not only to his splendid inventions at the dawn of the process, but also to his never-ceasing activity in the various organizations of which he was chairman. He was held in high esteem abroad as in his native country and his death means a great loss to the industry. His name will remain in the history of acetylene and autogeneous welding as a gifted pioneer and leader.

American Welding Society Annual Meeting

Preparations for the Annual Spring Meeting of the American Welding Society, which will be held April 22nd, 23rd and 24th in the Engineering Society's Building, 33 W. 39th Street, New York City, are now complete.

The technical sessions will include the following papers:

Wednesday Morning, April 22nd

"Welded Boilers for U. S. Navy Scout Cruisers," by J. C. Hodge, Barberton Works, Babcock and Wilcox Company.

"Welded Machinery Foundations for Ships," by G. H. Moore, Jr., Newport News Shipbuilding and Dry Dock Company.

Wednesday Afternoon, April 22nd

"Some Examples of Welding in Structural Steel Work," by D. C. Tennant, Structural Engineer, Dominion Bridge Company.

"Formula for Eccentrically Welded Connections," by Odd Albert, Bridge Designer, New Jersey Highway Commission.

"Some Tests of Gas Welded Structural Joints," by H. H. Moss, Linde Air Products Co.

Thursday Morning, April 23rd

"Some Resistance Welding Problems," by C. L. Pfeiffer, Western Electric Company.

"Strength and Characteristics of Various Types of Connections for Static and Dynamic Loadings," by C. H. Jennings, Westinghouse Electric & Manufacturing Company.

"Fusion Welding as Applied to High Pressure Heat Exchangers," by Marselis Powell, Whitlock Coil Pipe Company.

Thursday Afternoon, April 23rd

"Welding of Heating and Industrial Piping," by J. H. Zink, Chairman, Committee on Welding, Heating and Piping Contractors National Association.

Friday Morning, April 24th

"Thermit Welding in Maintenance in the Steel Mill," by J. H. Deppeler, Chief Engineer, Metal and Thermit Corporation.

"Metal Arc Welding of Copper Alloys," by Ira T. Hook, American Brass Company.

"High Tensile Atomic Hydrogen Arc Welds in Alloy Steels," by Frederick Ray, Consulting Engineer, Croll-Reynolds Engineering Company.

One of the features of the meeting will be the Annual Dinner on the evening of April 23rd. The dinner will be featured with music and entertainment on a par with that of previous years. The Committee has made every effort to insure the dinner being a gala affair.

A meeting of the Board of Directors will be held Wednesday evening at 7:30, at which committee chairmen for the coming year will be appointed and plans made for future activities.

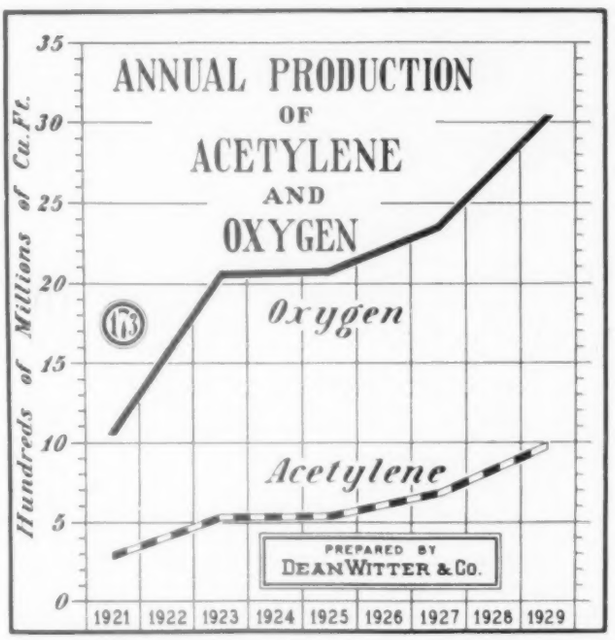
Part of the technical session on Thursday afternoon, April 23rd, will be a joint meeting with the Pressure Piping Code Committee of the American Standards Association. The Committee of the American Welding Society will present for discussion at this time a proposed section of a code dealing with the welding of pressure piping.

Friday afternoon, April 24th, will be devoted to meetings of the Structural Steel Welding Committee and the American Bureau of Welding. The former will present a report and analysis of test data which has been compiled by it. The American Bureau of Welding will report progress made by various research committees of the Bureau.

A very interesting inspection trip for Saturday morning, April 25th, has been arranged and will be in charge of Mr. Chas. Kandel. This inspection trip is to the New York Hospital and Cornell Medical Center at East 70th Street between York Avenue and East River. Visitors will have an opportunity of observing the layout of the main building and power house, as well as welded joints of various types in different stages of completion. This project involves over 50,000 feet of welded piping ranging in size from 2½ inches to 24 inches for transmission of hot water, brine and steam for low pressure and high pressure service.

Shows Recent Annual Production of Acetylene and Oxygen

An interesting chart has been prepared which shows the advancement in the production in recent years of Acetylene gas and Oxygen.



The Upward Trend of Welding and Cutting Gas Consumption.

Aggressive development of new uses for oxy-acetylene welding and cutting of metals, together with a greatly increased demand from the iron and steel industries have greatly expanded sales of oxygen and acetylene gas in recent years. Producers of welding and cutting gasses and equipment have been very successful in adapting their facilities in new fields. Owing, however, to the greater volume of oxygen than acetlyene required for cutting purposes, etc., the production of acetylene gas has not been maintained in proportion.

The above chart is furnished by the courtesy of Dean Witter & Co., widely known brokers and trade reporters and statisticians, and will doubtless be of value and interest to our readers.

Structural Welding Discussed at Meeting of Chicago Section

At the regular April meeting of the American Welding Society, Chicago Section, which was held at the Palmer

House, Chicago, April 3, the entire program was devoted to the subject of Structural Welding. The principal speaker of the evening was Mr. J. E. Ferguson, Manager of the Manufacturing Division, of the Austin Company, Cleveland, Ohio. Mr. Ferguson outlined the growth and the advantages of structural welding and pointed out some of the particularly important conditions in the industry at the present time which need attention in order to secure the more rapid development of the welding processes for the erection of steel buildings. He then showed a large number of lantern slides, illustrating the types of work which have been performed successfully by the Austin Company, showing particularly some of the details of design and procedure which make for economy and efficiency in such operations. Added interest was given to this paper by the showing of several slides, furnished through the courtesy of the Cleveland Crane and Engineering Company, to illustrate the successful use of welded construction in structures subjected to extremely heavy duty. J. I. Banash, Consulting Engineer, Chairman of the American Welding Society's Committee on the Chicago Building Code, outlined the present status of the building code situation in Chicago, as far as welding is concerned, and presided over the discussion of Mr. Ferguson's paper. An interesting portion of the discussion was furnished by J. C. Connoly, Chief of the Bureau of Sanitary Engineering, of the Dept. of Health, City of Chicago. Mr. Connoly spoke with particular emphasis of the desirability of substituting welding for riveting in order to get rid of the unnecessary noise of riveting and emphasized the point that few people realized how important the reduction of unnecessary noise may become as a factor in public welfare.

The next meeting of the Chicago Section will be Friday evening, May 1. This will be the final meeting of the Spring series. It is expected that the first Fall meeting will be held in October.

Welding Industry Well Represented At California Oil Exposition

The second annual Oil Equipment and Engineering Exposition held in Los Angeles, March 16th to 22nd, was an outstanding success from every angle. The attendance exceeded that of last year, and the exhibits and displays of equipment were more complete and covered a wider range than heretofore shown.

An interesting feature of the exposition was the unusually large attendance at the group sessions and meetings of the various societies and associations affiliated with the oil industry. One of these meetings was that of the American Welding Society in which much interest was shown.

Many exhibitors added interest to their display by having their equipment in operation, and, as nearly as was possible, representing the application of same under actual field conditions.

A large number of visitors from foreign countries and oil company representatives operating outside the United States were also in attendance, and a nice volume of sales of equipment was reported during the show.

The welding industry was well represented at the exposition. Among the exhibitors who had display booths of welding equipment and materials were The Shrader Electric Co., The Victor Welding Equipment Co., The Linde Air Products Co., The Stoody Co., Air Reduction Sales Co., Haynes Stellite Co., The National Oxygen and Acetylene Equipment Co., The General Electric Co., and Mills Alloys Corp.

New Welding Course Announced by Philadelphia School

The Kalix Trade School, located at 439 North 11th Street, Philadelphia, has recently announced a complete series of courses in gas and electric welding. This school is devoted to welding instruction and is a member of the Philadelphia Board of Trade and the Philadelphia Chamber of Commerce. According to a recent announcement the instructors are all men of many years of practical experience. All of the instruction is of a practical sort. The gas welding course consists of twelve 1½ hours lessons, costing $35.00 and the electric welding course, of the same length, is for a similar amount. The combined course, teaching both branches, is sold for $65.00. Both day and evening courses are offered. R. L. Kalix is supervisor in the school and J. F. Kelly and H. Killack are the instructors.

Waukegan Welders Club Makes Progress

Last year some of the welding fraternity in Waukegan, Ill., succeeded in getting a course of welding instruction started in the local high school. This instruction was largely taken advantage of by adult operators who were already employed. On several occasions men from out-of-town came to the school and gave the students little talks on subjects pertaining to the art of welding. As a result, there was organized the Waukegan Welders Club for the purpose of continuing the close association of those who were interested in learning more about their work and making it possible to continue to receive new ideas and instruction from such out-of-town authorities who might be available speakers. The officers of the club are President, Frank Hasse; Vice-President, James Purves; Secretary, Frank McKnelly; and Treasurer, Frank Tilman. Since the completion of the course at the high school, this organization has continued to hold monthly meetings. At the regular monthly meeting April 1st, which was held in the high school auditorium, there were about fifty of the local welders present. The program consisted of informal talks by W. A. Slack, president of the Torchweld Equipment Company; H. S. Card, editor of *The Welding Engineer* and J. M. Jardine, proprietor of the Western Welding and Boiler Repair Company, Chicago. This organization furnishes an opportunity for the exchange of ideas for a number of local men who would not be able to attend meetings of some of the national organizations which are held regularly in Chicago. The spirit of interest is high. It is evident that this type of organization fills a real want. There are probably a number of communities where a little organized effort of this sort would be very beneficial to local men. It requires quite a bit of generous effort on the part of a few men to get such a movement started, but if properly conducted the educational value would certainly more than repay the work put into it.

Welding Supply Dealer Holds Welding School

During the week of March 30th the Hays Supply Company of Memphis, Tenn., distributors of gas and electric welding equipment and supplies, conducted a welding school for the benefit of their customers. The hours of the school were from nine to eleven in the morning, one to five in the afternoon, and seven to ten in the evening. The school was in charge of Mr. L. H. Beacht of the Hays Supply Company and Frank C. Lane of the Bastian-Blessing Company, both of whom have had extensive experience in welding instruction work.

Motion Picture Program Given for Southern Pacific Employees

On March 26th Mr. G. E. Harcke of the Air Reduction Sales Company delivered a short lecture before 125 employees of the Southern Pacific Railroad at Houston, Texas. The lecture was followed by a demonstration of liquid oxygen and the showing of four reels of motion pictures, two of these reels being on the subject, "Oxygen—The Wonder Worker" and the other two on the subject, "The Magic Flame." The shop superintendent commented that

this program was the most instructive one that had ever been held at this shop and said he was certain that his men would benefit greatly from it. An informal question period was carried on for about 45 minutes after the completion of the regular program.

French Welding Society Now Occupies New Modern Building

January 24 witnessed the opening of the building erected in Paris, France, by the French manufacturers of carbide of calcium especially for the promotion of carbide, oxygen, acetylene and autogeneous welding. In this building are located the management, the offices, the laboratories of the Office Central de l'Acétylène et de la Soudure Autogène and the Institut de Soudure Autogène, a new organization, devoted especially to the teaching of autogeneous welding. The Chambre Syndicale de l'Acétylène et de la Soudure Autogène, as well as the Société des Ingénieurs Soudeurs also have their offices in this building.

This new arrangement also accommodates the foreign industries, because the Commission Permanente Internationale de l'Acétylène et de la Soudure Autogène decided in its last sitting to confide again to the Office Central its general secretarship for three more years. Consequently this Commission has its headquarters in the new building.

This New Building Houses the French Welding Society.

On January 24th took place the official opening by Mr. Labbé, General Director of the Enseignement technique, high representatives of science and of the Société des Ingénieurs Soudeurs of the Société de Chimie Industrielle, of the Société d'Encouragement à l'Industrie Nationale being present. Numerous manufacturers interested in autogeneous welding were also present, as well as the members of the Commission Permanente Internationale for which Hon. Senator Tofani and President Gandillon were spokesmen. The memory of Messrs. Gall and Sautter, president and founder of the Office Central was recalled by Mr. de Seynes, now president of the Office Central, in his speech.

On the first floor is the department of administration; on the second floor is the Ecole Supérieure de Soudure Autogène with its class rooms, its library, its technical office and its laboratory; on the third the other laboratories and technical offices; on the fourth the general library, the general files, the annexed branches, the central acetylene generator, the canteen and the dining-room.

The three practical working rooms for the teaching of autogeneous welding by all methods are one over another and are able to accommodate 60 pupils. On the ground-floor a large workshop accommodates the same pupils for real work on autogeneous welding by all processes. It will be supplied with the machines necessary to the preparation and the manufacturing of welded articles.

W. D. Flannery and E. N. Stevens Join Harris Calorific Company

Notice has been received during the current month of the establishment by W. D. Flannery of the Harris Calorific Sales Company, 136 Liberty Street, New York City, for the purpose of distributing Harris Calorific Company's products in the New York metropolitan district and E. N. Stevens as Assistant Sales Manager of the Harris Calorific Company, with headquarters at Cleveland, Ohio.

W. D. Flannery entered the gas welding and cutting field in November, 1907, when he became one of the first demonstrators of the equipment developed by Eugene Bournonville. In April, 1908, he installed for the S. L. Moore & Sons Company of Elizabeth, N. J., now known as the Bethlehem Shipbuilding Company, their first welding and cutting outfit along with an acetylene generating plant and one of the old-fashioned oxygen producing plants. The apparatus was used in connection with the construction of some of the machinery being built at that time for the Standard Oil Company which was, at that time, putting in the large Fay Way plant in Linden, N. J.

The following year Mr. Flannery joined the Oxy-Acetylene Appliance Company of New York City, who were at that time supplying Davis-Bournonville equipment for government use. He made the government installations at the Philadelphia Navy Yard, the Gun Factory at Washington, D. C., the Naval Training Station at Chicago, the Puget Sound installation and

W. D. Flannery.

the Panama Canal installation— these installations including not only welding apparatus but also oxygen and acetylene compressing plants. Another important installation handled at that time was that of the General Electric Company at Schenectady, N. Y.

In 1911 he opened up the Davis-Bournonville agency in St. Louis, and remained in St. Louis until the latter part of 1912, when he returned to New York and joined the Krajewski Pasant Company of Cuba, which was handling Davis-Bournonville apparatus and operating the Havana Oxygen & Acetylene Company of Regla, Cuba, where they not only compressed their own oxygen and acetylene, but also made the small automobile tanks which were used extensively at that time.

It was in 1914 that Mr. Flannery joined the K-G Welding & Cutting Company of New York City as a salesman. As a

E. N. Stevens.

result of his perseverance and efforts, he was advanced to the position of vice president and director of this company, which position he has held until a few weeks ago when he resigned to form his new connection with the Harris Calorific Company.

Mr. Flannery needs no introduction to the oxy-acetylene industry because during the past ten or twelve years his activities in organization work, particularly with the International Acetylene Association and the Gas Products Association, have been outstanding. At the present time he is President of the International Acetylene Association, a director of the Gas Products Association, and an active member of the American Welding Society.

E. N. Stevens has long been known as "Steve" in oxy-acetylene circles. His connection with the industry dates back to 1912, when he was connected with the Anderson Manufacturing Company of Coffeyville, Kansas, who were among the pioneer manufacturers of oxygen generators, hand feed acetylene generators and welding and cutting torches. While with that company, he realized the need of educational work and put his ideas into action by going out in the rural sections of Kansas and calling together the men who should be interested in different communities for demonstrations of welding and cutting, thus pioneering the idea which today has developed into the welding conferences held in different parts of the country. In his later work he kept up this activity, and in some cases held meetings of the nature of welding clinics in tents.

In 1914 Mr. Stevens joined the Superior Oxygen Company of St. Louis. This company was later joined with the Air Reduction Company. He spent about a year with their distributors—the Faeth Iron Company of Kansas City, Mo. He joined the sales force of the Imperial Brass Mfg. Company of Chicago, Ill., in 1915. He spent several years with their distributors—the Kansas City Oxygen Gas Company, and was later called to Chicago as assistant to Mr. W. S. Noyes. Altogether, he was connected with the Imperial Brass organization for about twelve years.

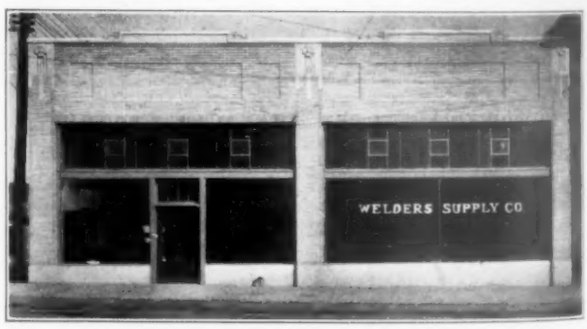
For the past three and one-half years Mr. Stevens has been connected with the Bastian-Blessing Company of Chicago as Assistant Sales Manager. Throughout his connection with the industry, he has traveled extensively and has made friends everywhere. His position with the Harris Calorific Company is that of Assistant Sales Manager.

Good Welding Course Under Way in Junior High School

Boosters of practical courses in school training could draw a big evening of satisfaction out of attending a session of the oxy-acetylene welding class at Boyd Junior High School, Knoxville, Tenn., according to a recent story in the Knoxville News Sentinel. The instructor—G. J. Hardy—has a good size class of southern shop men and unemployed men, and the school provides a twelve-weeks' night course with two lessons per week at a very nominal cost. Since the tuition fee is intended to cover only the cost of materials, students themselves aid in keeping this cost down by bringing in scrap materials to use for the shop practice work. M. E. White, District Manager of the Burdett Oxygen Company at Knoxville, Tenn., points out that this is a course conducted primarily for adult education and that the need for such a course was indicated as a result of the welding clinic held at the Burdett plant last spring. One night class in the high school was started last September and completed a three months' course. The second class, which started in January, is now nearing the completion of its work.

Welders Supply Co., of Tulsa in New Home

Welders Supply Co., Tulsa, Okla., one of the best known exclusive distributors of welding supplies in the Southwest, has completed and is now occupying its new home at 311 East Third Street, adjoining its old location. The new building is a brick and concrete structure, 50x65 feet, and two stories high. Among its features are an equipment display room, a welding demonstration room and a completely equipped welding shop for use of customers which is provided with both electric and gas equipment.



New Home of the Welder's Supply Company in Tulsa.

This company is distributor in the Mid-Continent field for a number of leading manufacturers, including Stoody Co., Whittier, Cal., USL Battery Corp., Niagara Falls, N. Y., Imperial Brass Mfg. Co., Chicago, Modern Engineering Co., St. Louis, Victor Welding Equipment Co., San Francisco, Calif., and Wilson Welder & Metals Co., Inc., North Bergen, N. J. In addition to the home office at Tulsa, branches are maintained at Oklahoma City, Dallas and Houston. C. B. Harter is president and general manager, C. R. McCullough, vice-president, and W. L. Porter, secretary-treasurer. Since its organization in November, 1925, the company has enjoyed a phenomenal growth.

Taylor-Winfield Sales Organization Meets at Warren

The Taylor-Winfield Corp. was host March 28 to the men of its entire sales organization, who gathered for their annual sales meeting from the various offices in New York, Chicago, Detroit, Philadelphia, Cleveland and St. Louis. The program and arrangements were in the hands of Mr. Walter Anderson of Detroit, Vice-President in Charge of Sales, and included a demonstration of the new twelve-hundred KVA sixty-five-ton pipe welder and seven-hundred KVA tube welder, both of which have recently been completed at the Taylor-Winfield plant.

In the afternoon the men met at the factory and were addressed by Mr. Van Buskirk of the Cleveland Office of the Commercial Credit Co., and Mr. Malcolm Clark, Chief Engineer, and Mr. James A. Muir, General Manager of the Taylor-Winfield Corp. They were next shown complete moving pictures of the latest welding units developed by the engineering staff at the Warren office. In the evening at a banquet held at the Warner Hotel and attended by the sales organization and heads of the manufacturing departments, the men had the pleasure of hearing addresses by Mr. G. P. Gillmer, Chairman of the Board and Mr. Walter Anderson, Vice-President. On Sunday, for dinner, they were entertained at the Youngstown Country Club.

The executive heads of the Taylor-Winfield Corporation expressed themselves as exceedingly gratified with the results of the Sales Convention. Mr. J. A. Anderson, President, stated, "with business conditions on the uptrend and with the splendid spirit displayed by the men of our organization, the outlook for the future is very promising."

New Chicago Headquarters for Lincoln Electric

The Lincoln Electric Company, Cleveland, Ohio, manufacturers of "Stable-Arc" welders, announce the removal of their Chicago office from 53 West Jackson Blvd., to a new building at 1455 West 37th Street. This move is made to provide additional space for the sales and service of Lincoln "Stable-Arc" Welders, "Linc-Weld" motors, and to provide additional storage space for a complete stock of welders, welding supplies and accessories.

G. G. Landis Made Chief Engineer of Lincoln Electric

Announcement has recently been made of the advancement of George G. Landis to Chief Engineer of the Lincoln Electric Company, Cleveland, Ohio. Engineer Landis is a graduate of Ohio State University where he completed the course in Electrical Engineering, receiving the degree of Bachelor of Science in Electrical Engineering. Upon graduation he entered the employ of the General Electric Company where he engaged in the design of small motors. He later went to the Westinghouse Electric Company as sales engineer for central station equipment. Mr. Landis came to the Lincoln Electric Company eight years ago when he was placed in charge of this company's experimental activities. He was later placed in charge of electrical design of both motors and arc welders, and some time afterward was given charge of mechanical design. Many of the patents held by his em-

George G. Landis.

ployers, both on arc welding equipment and electric motors, are the result of his ingenious efforts. He is a member of Eta Kappa Nu, honorary Electrical Engineering Society, and Theta Psi, honorary Scientific Society.

Merger of Two Pioneer Companies on Pacific Coast

Victor Welding Equipment Co., with headquarters and plant at San Francisco, Calif., and the Kimball-Krogh Pump Co., with plants at Los Angeles and San Francisco, Calif., have been merged into the Victor Equipment Co., as stated in a preliminary announcement which was published in the March issue of *The Welding Engineer*. Both Victor Welding Equipment and Kimball-Krogh pumps will continue to be sold under their well known trade-marks and the two original companies will be operated as individual divisions by the newly formed company.

The object of this merger, according to E. L. Mathey, vice-president, is to strengthen the engineering and research facilities; to enlarge the domestic and foreign sales fields; to consolidate and expand warehousing, trucking, and delivery service.

The Victor Equipment Co. will be under the management of the men who have contributed so materially to the development of the two companies involved in this merger. Mr. L. W. Stettner as President will be assisted by Mr. E. L. Mathy as Vice-President in charge of sales promotion and advertising, Mr. Geo. Pennington as Vice-President and General Manager of the Kimball-Krogh division, Mr. Ronald Schlegel as Vice-President and assistant to Mr. Pennington, and Mr. Wm. Fulwider, Secretary, in charge of Accounting.

Three factories and three company owned stores and warehouses, trucking and installation facilities will contribute to the new company's ability to render prompt and efficient service.

Proper Use of Cast Iron Electrodes Described in Bulletin

The latest bulletin issued by the American Arc Welders, Roseau, Minn., carries a new set of instructions for using Arcast cast iron welding electrodes manufactured by that company. These electrodes are made of gray cast iron and are flux coated. The illustrations show the method recommended for getting the most satisfactory results and particularly for insuring machinability of the weld.

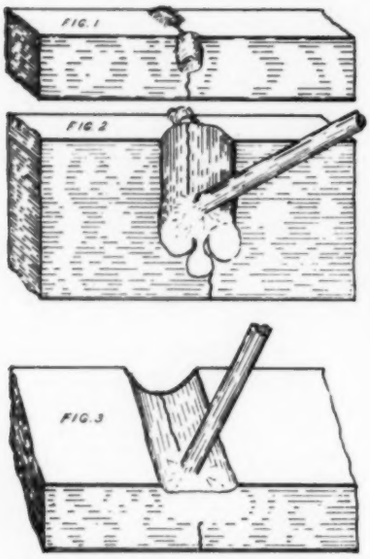


Figure 1. Fractured Parts Are Fitted Together and Tacked. A Vee is Cut (Figure 2) and Then Filled as Shown in Figure 3.

Fig. 1 shows the fractured parts fitted together and tack welded on one side with a steel electrode. Fig. 2 shows the broken piece turned up so that the fracture is in a vertical position with the Arcast electrode being used to melt out the base metal and forming a deep groove. The work is then laid back again in a flat position and the Arcast electrode used as indicated in Fig. 3, for filling up the groove. The arc must be manipulated so that no part of the deposit comes out of the white heat in less than 30 seconds and the deposit must be puddled instead of being laid in beads as in steel welding. Sufficient current must be used to make the rod flow freely. In many cases it is advisable to weld the job from both sides. The procedure in such cases is the same as that outlined above. Particular care must be taken in the second step illustrated in Fig. 2, to melt away enough base metal so that the deposit made from the reverse side is reached. After the welding is completed, the work must be allowed to cool slowly.

New Supply Firm in Cleveland

Buckeye Welding Supply Company, formerly of Cleveland, has been discontinued and Mr. W. H. Martin, who was the organizer of that company, has organized a firm known as W. H. Martin and Associates with headquarters at 749 Union Trust Building, Cleveland, Ohio. This firm acts as manufacturers representative handling Koro Welding Rods, Atlas Cast Iron Welding Rods and other welding brazing rods, fluxes, silver solders, etc. Mr. Martin has affiliated with him L. F. Beecher, formerly General Manager of the Buckeye Welding Supply Company and Mr. A. C. Arnold, who for eight years represented the Air Reduction Company in the Youngstown territory.

Standard Manual on Pipe Welding Now Ready

Announcement has just been made that the Standard Manual on Pipe Welding prepared by the Heating & Piping Contractors' National Association, which was described in a recent issue of *The Welding Engineer*, is now ready for distribution. The volume is a comprehensive and thorough treatment of the theory and practice of pipe welding. It contains 280 pages, is well illustrated, and bound in flexible imitation leather binding. The arrangement of the material is such that men in different groups will find the subject matter in which they are most interested in certain locations in the book; for example, architects and engineers will be most interested in Part 5 which contains specifications, standards, and data. This information of course, is useful to the contractor, but the latter will also make considerable use of Part 4 which includes design data and information regarding applications and management. The workmen will be particularly interested in Part 3 which gives practical helps on every phase of assembly and installation work. The price of the book is $5.00 a copy, and it is obtainable from the Heating & Piping Contractors' National Association, 50 Union Square East, New York City.

New Booklet Describes Welding Products

The Western Welding Supply Company, Inc., 4517 E. 50th Street, Los Angeles, Calif., has recently issued a pocket size booklet which contains a list of the products manufactured by the company and marketed under the trade name, "Westco." The products comprise a complete line of plain and prepared welding wire and electrodes of various grades, and in addition, a newly developed type of coated wire of various grades. Arc welding machines and welding supplies are also included.

Will Publish Instructions for Silver Brazing Nickel and Its Alloys

In a forthcoming issue of *Inco Magazine*, to be published by the International Nickel Company, 67 Wall Street, New York City, about May 15, there is to be a comprehensive article on the subject of welding monel metal and nickel. It is explained that the silver solders are more properly to be regarded as brazing materials because they fill an important part of the wide temperature gap between lead-tin solders and the usual brazing or welding materials. The article discusses in detail the principal characteristics of silver solders and then proceeds to tell how to use these silver solders with particular reference to the special applications of monel metal and nickel. It concludes with a list of products in the fabrication of which the silver soldering of monel metal on nickel parts play an important role.

Warner Engineering Corporation Prepares "Book of Applications"

A Book of Applications has recently been prepared by the Warner Engineering Corporation, Pomona, California, manufacturers of the Weco electric torch. The book consists of loose-leaf processed sheets in a strong paper binder. A couple of the introductory pages are filled up with long lists of uses for the electric torch in various types of shops. This is followed by a series of experiences and demonstrations showing in some cases how customers discovered the usefulness of the device; in other cases how special methods of manipulation were developed to take care of difficult jobs; and in other cases showing the results of experiments made on various alloys. The booklet is instructive from the point of view of both application and technique.

New Carbon Brush Manual Issued by National

The National Carbon Company, Cleveland, Ohio, have issued a new carbon brush manual which is designed to greatly simplify the selection and specification of carbon and metal-graphite brushes. The new shunt nomenclature of the National Electrical Manufacturers Association has been

adopted. The essential details for a complete brush specification are listed and discussed in the sequence which has been found most convenient. Tables of physical characteristics have been omitted. Instead, a cross index of grades and their applications simplifies the selection of a suitable grade for any service. Examples illustrate the manner in which the composite specification for a brush is derived and the price computed.

New Bulletin on Owen Welder

The Owen Electric Manufacturing Company, Fayetteville, N. C., are distributing a recently published bulletin, containing four pages of information regarding the Owen Production Arc Welder. The first and last pages of the bulletin include a general description with illustrations, together with specifications covering the various types and sizes. The two inside pages show illustrations of the various classes of work which are being performed with this machine and in many cases gives details concerning the actual costs of the welding jobs and the profits made on them.

English Book Contains Seven Prize Papers on Welding

The Institute of Welding Engineers, 30 Red Lion Square, London, England, has prepared in book form, under the title, "Welding Practice and Methods Based on My Own Experience". A collection of seven papers written by operators in competition for a gold medal and prizes offered in 1930 by the Institute. These papers give particulars and drawings showing the use of welding on tanks of many varieties, tubes, high pressure piping, repair work on cast iron, piping, aluminum, crank cases, for boiler repairs, derricks, steel buildings, duralumin, high carbon steel and many other interesting jobs. *The Welding Engineer* has made arrangements to carry a stock of these books which will soon be made available to our readers.

Stainless Steel Electrode Announced by Lincoln

A new electrode for the arc welding of stainless steel has been recently developed by the Lincoln Research Laboratories and is now in manufacture by the Lincoln Electric Co., Cleveland, Ohio. The electrode will be known to the trade as the Stainweld A. It is an extruded electrode and is used with reverse polarity. The coating contains no carbon. This eliminates all possibility of the molten weld metal

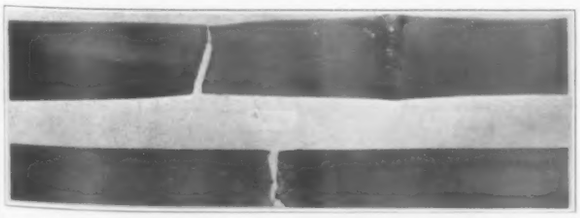


Figure 1. (Above) Coupon with Weld Ground Flush on One Side Broke in Plate. Figure 2 (Below) High Strength Was Shown When the Weld Area Was Reduced.

absorbing carbon from the electrode coating during the welding process. As a result of this feature the carbon content of weld metal deposited by the new electrode will always be equal to or less than the carbon content of the stainless steel being welded. This is said to have an important bearing upon the resistant qualities of the weld since a slight increase in carbon in the weld has been indicated as a cause of more rapid corrosion. Welds deposited by this electrode are produced in a "shielded arc" which acts to prevent the combination of atmospheric oxygen and nitrogen with the molten weld metal to form oxides and nitrides in the weld.

Physical and chemical tests have shown high tensile strength, ductility and resistance to corrosion in welds produced with the Stainweld A electrode. The accompanying photograph shows in Figure 1, a tension test sample with weld ground flush with the plate metal on one side only which broke in the plate at considerable distance from the weld under the tension of 96,000 lbs. per square inch. When the cross sectional area of the weld metal on another test coupon was reduced below that of the plate metal in order to obtain the break in the weld it required pull of 96,800 lbs. per square inch to break the weld as shown in Figure 2.

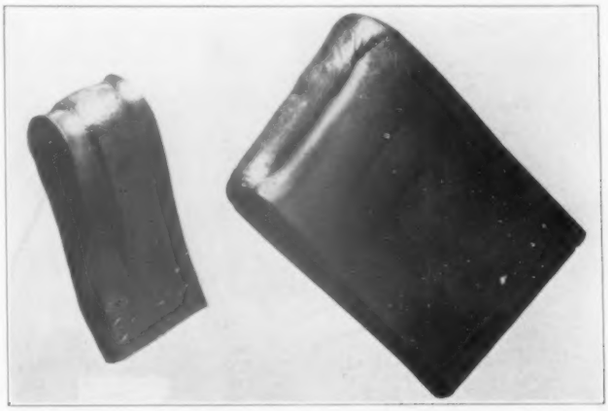


Figure 3. Showing the Ductile Properties of Stainweld A Welds.

Though the Stainweld A welds possess a high tensile strength, it is claimed that ductility of the weld metal is not sacrificed. This is substantiated by the bend tests shown in Figure 3. In addition to this advantageous physical characteristic the manufacturers state that the weld metal has a fine metal structure with no porosity. The new electrodes are manufactured in 3/32 in., 1/8 in., 5/32 in., 3/16 in. and 1/4 in. sizes of the regular 11-inch lengths.

Two New Electrodes Announced by American Arc Welders

Announcement has been received of two new welding materials by American Arc Welders, Roseau, Minn., also manufacturers of Arcast cast iron welding electrodes. One of these is called the Copper-Arc, which is claimed to make a copper alloy deposit having a tensile strength from 35,000 to 45,000 lbs. It is recommended for welding of cast iron, malleable iron, copper and brass without pre-heating. It is claimed the deposited material possesses greater strength than cast iron with the additional advantage of being able to withstand shock. This material is available in sizes ⅛", $\frac{5}{32}$" and $\frac{3}{16}$".

The other electrode is a fluxed pure copper welding electrode sold under the trade name Arco. This rod is said to possess great malleability and is recommended for fast, tight fills on cast iron where strength is not the first essential. Deposits having a tensile strength up to 23,000 lbs. have been made. This material is also recommended for the metallic arc welding of copper and for horizontal welding on cracked water jackets and cylinder heads. It is available in sizes from $\frac{3}{32}$" up.

Two New Prest-O-Weld Blowpipes Announced by Linde

The Linde Air Products Company, 30 East 42nd Street, New York, N. Y., has recently added two new welding blowpipes to its line of Prest-O-Weld medium pressure apparatus, presenting an entirely new idea in blowpipe design. A detachable valve body, to which the handle is secured by a

simple and convenient locking device, enables the operator to change quickly from the standard to different handles without detaching hose or hose connections and without the use of a wrench.

Designated as the Prest-O-Weld Type W-105 Welding Blowpipe (Fig. 1), and Type W-106 Welding Blowpipe (Fig. 2), these two new additions to the line have been designed to give Prest-O-Weld users a medium pressure blowpipe comparable in range to the Oxweld Type W-17 Welding Blowpipe.

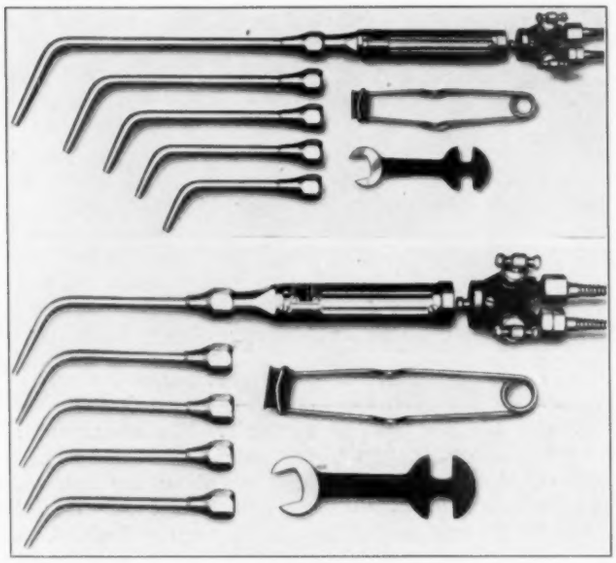


Figure 1. (Above) Type W-105 Blowpipe. Figure 2. (Below) Type W-106 Blowpipe.

Both blowpipes are designed for use with new type, one-piece, hard drawn copper welding tips. Although regularly supplied with a head angle of 60 degrees, this may be changed by the user to any angle desired. Ten different sizes of tips, Nos. 4 to 13 inclusive, are available for use with the Type W-105 handle. The Type W-105 Blowpipe, as furnished complete, includes tips Nos. 4, 6, 8, 10 and 12. A stem adapter is available so that tips for the Prest-O-Weld Type W-107 Aircraft Welding Blowpipe may be used with the Type W-105. This makes the new blowpipe adaptable for work ranging from the lightest sheet metal welding to heavy welding work requiring a No. 13 welding tip.

The Prest-O-Weld Type W-106 Blowpipe is similar in design to the Type W-105, but smaller. It is supplied with five sizes of tips, Nos. 3 to 7 inclusive, which cover a wide range of usefulness. The Type W-106 Blowpipe is particularly suited to automobile repair shops for general light welding, bronze-welding small parts, and for soldering. It is also suitable for sheet metal plants in production work. A stem adapter is available so that Type W-107 tips may be used with the Type W-106 handle.

Armite Laboratories Announce New Hard Facing Materials

A group of new hard-facing products for application on friction surfaces has been developed by Armite Laboratories in Los Angeles, California. These are for application both with the electric arc and by the oxy-acetylene method. The laboratory has developed several grades of inserts and compounds, ranging in size from 20-mesh to ½-inch diameter for application to drilling bits, power shovel teeth and for other services where inserts are desirable. The company has also developed a new product which is a tungsten carbide compound that can be applied direct to any type of steel, and by special application to manganese. This product, known as Armite Arcweld, is applied with an electric arc using a negative carbon electrode. The same material in tube form, known as Armite Autoweld, is also being introduced. The laboratory, in addition to manufacturing materials of diamond-like hardness, has also developed a hard-facing rod of light weight. This hard-facing rod is made in three grades of varying hardness.

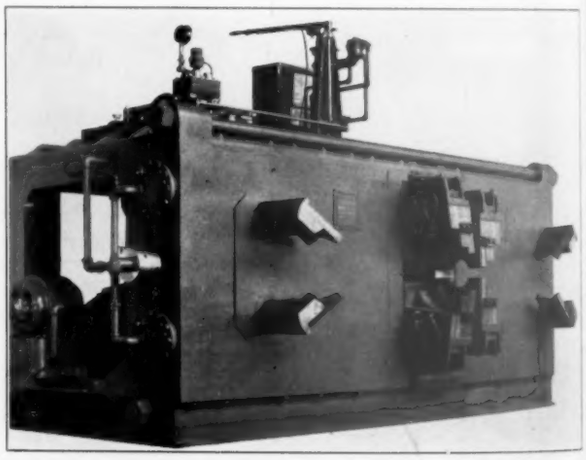
Taylor-Winfield Corporation Announces New Pipe Welder

One of the latest developments of the Taylor-Winfield Corporation, Warren, Ohio, is the new HP-12 Pipe Welder. A similar machine, somewhat smaller, with capacity to butt weld pipes from two inches in diameter up to ten inches in diameter inclusive, went into production about eight months ago at a large steel plant and it is reported that from the start its operation was very gratifying, to the extent that the production schedule exceeded, by almost one hundred per-cent, the figures expected.

The latest machine of this type to be built has a much wider range of capacities. Its purpose is to make what is termed double length pipe, by butt welding two standard lengths end to end to make lengths approximately forty-eight feet long. The range of sizes which may be welded on this unit is from two to sixteen inch standard pipe sizes inclusive. An upset pressure of two hundred thousand pounds is available, when required, without noticeable deflection. The complete machine weighs 65 tons.

The complete operating controls for the air clamping, hydraulic automatic, and the electric energy, are all conveniently located to the operator's cage on top of the machine, where he is able to see the pipe and the weld at all times without making a move and losing valuable time, thus obtaining the largest possible production.

The hydraulic automatic feature is an important part of the equipment and by it much flexibility becomes available in the unit: This accounts for the large range of sizes which can be handled. The upset pressure can be quickly adjusted to suit small or large size pipe, also the welding time may be changed by the adjusting of a dial to any required amount of time from four to forty seconds. The length of stroke for the burn-off can be changed by means of a set screw.



The New Taylor-Winfield HP-12 Pipe Welder.

The adjustments necessary on this hydraulic automatic unit to change from one size pipe to another size are so simple and convenient that the time required for a change-over is only a matter of seconds. The welding dies and back-up shoes must also be changed to suit the size pipe to be welded. These are equally convenient to install.

Due to the extreme range of pipe sizes which are to be welded on these units, a transformer with the proper flexibility must be provided. This requires not only a great range

of secondary voltages but also various ampere capacities, hence the multi-coil system is adopted whereby it has four distinct ampere capacities with four different secondary voltages for each capacity, giving sixteen different heating ranges. Another important feature in the design of the machine is that the transformer is right up close to the weld. This feature, along with the close loops in the flexible connections to the clamping jaws, accounts for the high power factor at which this unit is tested.

This same type of Pipe Welder can be furnished in the following size ranges:

One and one-half inches to six inches; two inches to ten inches; two inches to sixteen inches; fourteen inches to twenty-four inches inclusive.

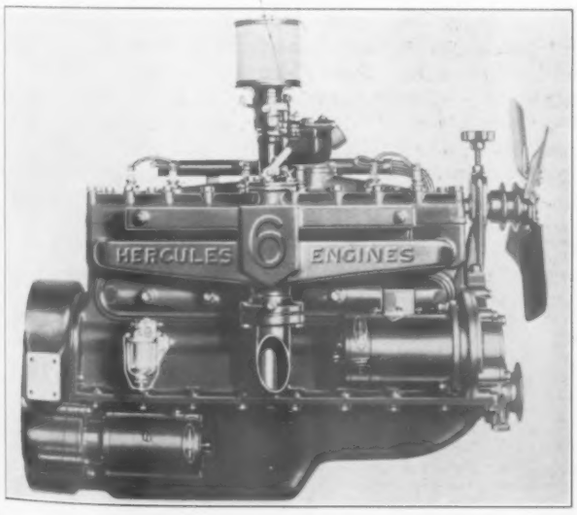
Hercules Building Series of Small, Heavy-Duty Sixes

The Hercules Motors Corporation of Canton, Ohio, is offering an additional line of heavy duty, six cylinder "L" head engines, designated as the "JX" series. This "JX" series is available in three different sizes, as follows:

Model	Bore	Stroke	Displacement
JXA	3⅜	4¼	228 cu. in.
JXB	3⅝	4¼	263 cu. in
JXC	3¾	4¼	282 cu. in.

All three engines are identical in design and in installation dimensions. They differ only with respect to the bore and such parts and performance ability as are thus affected.

While the "JX" series is a strictly heavy duty line, all sizes are designed to meet present day needs and to withstand the stresses of high speed operation. Simplicity in one of the outstanding features of these models. It is also interesting to note that the "JX" series six cylinder motors are companion models to the well known "00" series of four cylinder engines. Many of the parts such as the connecting rods, timing gears, valve mechanims, etc., are interchangeable. Thus in cases where either small fours or sixes may be required extensive interchangeability features are provided in the "JX" and "00" series.



Intake Side of Hercules "JX" Series Engine.

The horsepower and torque ability of all engines in the "JX" series make them suited for commercial cars of ¾ to 1½ ton capacity, and other heavy-duty uses, where low speed torque and, at times, rather high engine speed performance are necessary. Such uses embrace agricultural, general, industrial and oil field applications, including pump and generator drives.

As regularly supplied, the horsepower of all three sizes "peaks" at between 3000 and 3100 RPM.

The same standardization of heavy-duty design has been carried out in the "JX" series as in all other engines produced by Hercules. Special attention has been given to proper cooling, particularly of the valves, which function through well cooled valve guides. Mushroom valve lifters of ample proportions to assure long life, together with the cam contour and spring tension on the valves, make for quiet operation.

New Welding Goggle Announced by Willson

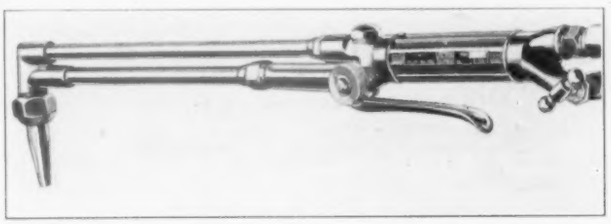
One of the latest additions to the line of high protective products manufactured by Willson Products, Inc., Reading, Pa., is the new Bull Dog welder's goggle. This is made in a new shape which is illustrated in the accompanying photograph. The cups have broad bearing surfaces which assure

The New "Bull Dog" Goggle.

proper fit and great comfort because they are patterned after the anatomical structure of the eye so that when in use there is a uniform distribution of pressure. A new type of bridge is also incorporated in this goggle, permitting a simple adjustment to secure a permanent bridge width. The bridge is so placed that it does not rub on the nose. There is a ventilating device which permits the generous flow of air into the cup but excludes stray light and incandescent sparks. The manufacturers claim that this goggle is moisture-proof and will withstand hard abuse.

New Type of Cutting Torch Announced by Victor

The latest addition to the line of welding and cutting equipment manufactured by the Victor Welding Equipment Company, San Francisco, California, is a new type of cutting torch. The accompanying illustration gives a good idea of the general appearance and construction of this new number. The manufacturers lay particular emphasis on the special features of design which make the torch remarkably free from back-firing. Working tests have already been carried



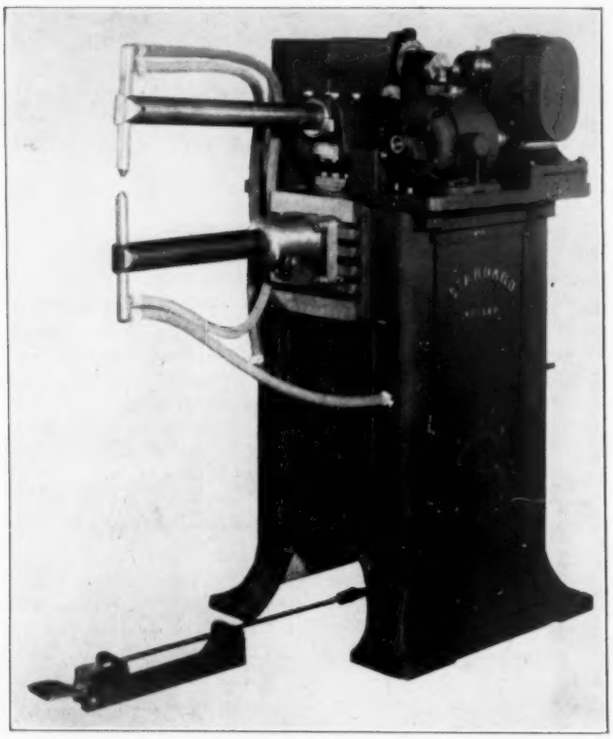
New Cutting Torch Announced by Victor.

out to indicate that it has great ability to stand up under abusive use. It is well balanced so that it can be handled by the operator under conditions of continuous use with comparatively little fatigue. Special attention has also been given to the design of the torch handle and the high pressure trigger valve to secure a high degree of hand comfort for the operator. In other words, it has been the aim of the manu-

facturers to produce a torch which is in all respects adapted to strenuous service. A new bulletin, No. 75, has been prepared to furnish complete details regarding the construction and design.

Lenney Adds Automatic Spot Welder for Medium Heavy Work

The Lenney Machine & Manufacturing Company, Warren, Ohio, have added to their line of "STANDARD" Spot Welders, a medium priced medium heavy duty automatic spot welder in 20, 25 and 33 KVA capacities. This welder is top drive, with all mechanism mounted on the base and taking the same floor space as the foot power machines of the same capacity. The action is positive and smooth, all jar and vibration being eliminated. The construction is rugged, and the operative mechanism simple and compact. The automatic switch is also mounted on top of the machine, driven directly from the main shaft and has a wide range of contact time. Power is supplied by one-half horse power motor and is controlled by a foot treadle which operates a positive

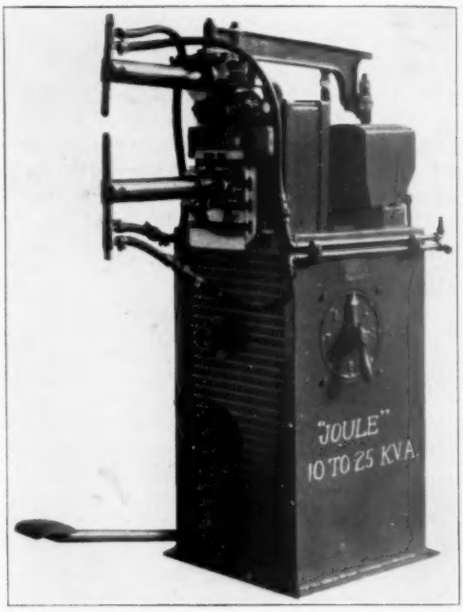


Lenney Medium Heavy Duty Automatic Spot Welder.

clutch. Five speed changes are provided from 45 to 140 R.P.M., and current regulation is by means of an auto coil with eight steps, covering a very wide range in speed and current control combinations. The features claimed for this welder are: smooth and positive action, strength and simplicity of construction, wide range in speed and current control, small number of working parts, and low maintenance cost.

"Joule" Spot Welder Announced by Federal

The Federal Machine and Welder Company, Warren, Ohio, manufacturers of resistance welding equipment, have recently announced a new line of production spot welders called the "Joule." The typical machine of this line is featured as a compact, sturdy and reliable production spot welding machine. It is simple from both the electrical and mechanical standpoints; is made for either foot power or automatic operation. An interesting feature of the new line is that welded steel has replaced important parts which were formerly cast. This machine will weld pieces up to $\frac{1}{2}$" manually and up to $\frac{5}{32}$" with the slow speed power drive. Its special field is given as between 20 gauge and 11 gauge. The machine



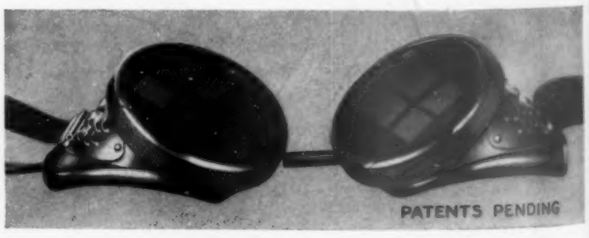
The New "Joule" Federal Welder

is 50" high and is obtainable in throat depths from 20" to 24". Welding speeds from 60 to 180 welds per minute may be obtained with a multi-speed motor. The frame, itself, is fabricated and welded from structural steel. The transformer is of special unit design; the capacity from 13 to 26 KVA and is so mounted as to give a very close coupled circuit.

Special Eyecup Design a Feature of New AO Duraweld Goggle

The Safety Division of American Optical Company, Southbridge, Mass., is now announcing a new type of welder's goggle having individually designed eyecups. The nasal side of the Duraweld eyecup is slanted in to follow the nose as it expands from the bridge to the cheek, and the temple sides are flared out to follow the forehead. In other words, the eyecups are anatomically shaped. According to the manufacturers this is possible because they are individually designed for right and left orbits.

The snug, comfortable fit afforded also serves to protect against sparks, scale, and stray rays of injurious light. A combination of larger lenses and lower eyecups has also been

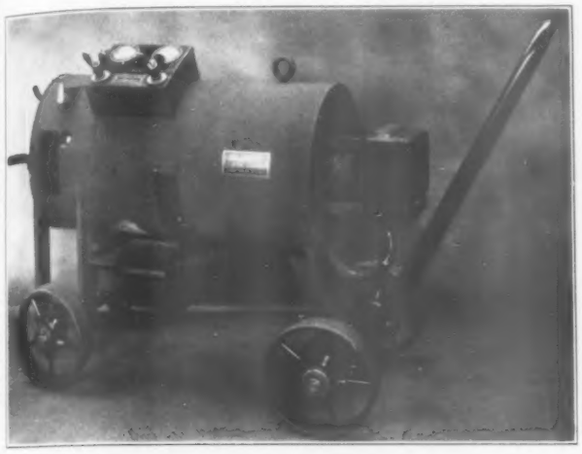


The Redesigned Duraweld Goggle.

incorporated in the design to allow increased vision. The Duraweld goggle also introduces a new type ball chain bridge which may be permanently adjusted to the right size for the wearer, a new one-piece headband, and deep side shields, providing for a good circulation of air in the eyecups. A circular describing this goggle in further detail has just been issued, and may be obtained by writing the manufacturer.

New Burke Model Shows Simplified Design

Recent changes which have been made in the construction of the Burke arc generator, made by the Burke Electric Company, Erie, Pa., have been followed by further simplifying the design of the exterior parts of the machine. As shown in the accompanying illustration, this offers a lesser

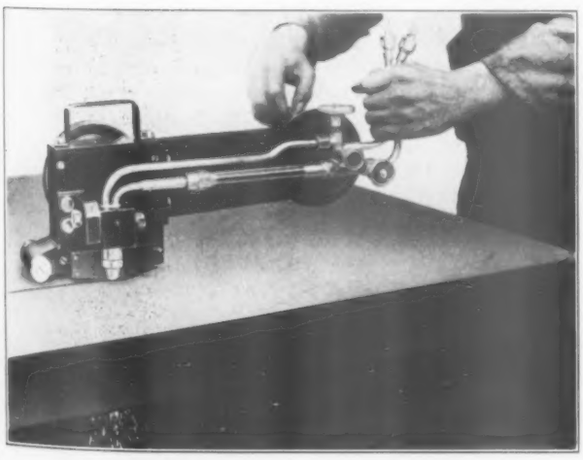


Simplified Design of New Burke Model.

number of exposed parts and a more compact unit, features which the manufacturers indicate will improve the portability, ease of handling and maintenance of the machine. Working parts are better protected than ever from falling objects and from possible injury due to collisions with other equipment. In this machine, as in other Burke models, the exciter is built into the machine itself.

Portable Hand-Guide for Cutting Torches

Jos. C. Paulus & Co., 2507 Potter St., Philadelphia, Pa., have recently introduced a device which is marketed under the name of Paulus Clean Cut Guide. This is a small, port-



Paulus Portable Hand-Driven Cutting Machine.

able, hand-propelled oxy-acetylene cutting machine geared forty-eight to one so that the torch can be moved with an even motion. It is designed to meet the requirements of firms who desire clean and accurate cutting, but who do not have a sufficient volume of cutting to warrant the purchase of electrically driven machines. The machine rides on the metal keeping the torch always the same distance from the steel. The torch is of the low-pressure injector type with a round ring pre-heating flame and is claimed to be economical in gas consumption.

News of the Industry

While running in the plant of the Northwestern Woodenware Company, Tacoma, Wash., an 108-inch cut-off saw which carried a weld of 72 inches, broke into flying pieces recently when the mandrel gave way between the bearings. No part of the weld broke or opened or was affected in any degree. The saw was being operated by a 150 H. P. motor at a rim speed of 15,000 revolutions. The saw originally had lost a large segment in a Grays Harbor plant when it struck a spike, the segment going out of the mill into the water. It was welded by the Vance Scales Company, Tacoma, by the atomic hydrogen process, and put into regular operation at the woodenware plant.

A branch shop is being established by the American Iron and Machine Works Co., in Kilgore, Texas, which is in the east Texas oil field. The company's shop, located at Maud, Okla., is being discontinued. General oil field machine and welding work is featured by the company.

The Southern Counties Gas Co., of Los Angeles, Calif., is laying an all welded gas line from their compressor plant in the Santa Fe Springs oil field to Whittier. The welding is entirely by oxy-acetylene.

The Progressive Welding Works, formerly located at Florence and Alameda Avenues in Huntington Park, Calif., have moved their equipment to 215 N. Alameda, in Compton, where they are opening a new shop under the name of the Security Welding and Tank Mfg. Co. The new company will specialize in the manufacture of welded gasoline storage tanks. Mr. C. C. Forbes is manager of the company.

A. O. Woods has assumed the duties of plant superintendent of the Southwestern Tool Co., of Signal Hill, Calif., replacing Mr. C. H. Mangels, who recently resigned. This company features all kinds of oil field welding and machine work.

A 4½-inch gas welded line has recently been started by the State Fuel Supply Co., of Oklahoma. This pipe line will be about eight miles in length, and will carry gas for domestic consumption for the city of Laverne. This company is also contemplating the laying of a similar line to Buffalo, Oklahoma, in the near future.

Ford, Bacon & Davis, Inc., Engineers, New York City, have been awarded the contract for construction of the last section of the natural gas pipe line which extends more than 950 miles from the Texas Panhandle to Chicago. The last or seventh link of this project, running from Rock Island to Joliet, Ill., will be 155 miles long and the contract provides for its completion on or before July 1.

The Exeter Oil Co., of California, has awarded a contract to the C. F. Braun Co., for the welding work and construction of a fractionating tower at the old Italo Oil Company's plant at Hines, which has been shut down for several months. The modernization of this plant will require a great deal of welding and cutting. The plant is expected to be in operation in April.

Construction work was recently started on a two-unit gasoline plant to be erected by the Eason Oil Co., of Guthrie, Oklahoma, on their discovery lease in Logan County, west of the city of Guthrie. This work will afford a considerable amount of welding work for welders in that section.

Contract for building nine large tanks and truck tanks for the Valvoline Oil Company has been awarded to the Steel Tank & Pipe Company, Portland, Ore. The firm also secured contract for erecting three storage tanks for the Western Oil & Refining Company, at Linnton, Ore.

Earl Bates, owner and manager of a welding shop located in Cambridge, O., has completed moving his business into his recently constructed $18,000 fireproof building. An overhead crane has been installed to handle heavy work. One feature of this building is that half of the wall area is of glass. It is located on the second main street in the city and the shop is equipped with the latest electric and oxy-acetylene welding equipment.

USL Battery Corporation, Niagara Falls, N. Y., has recently appointed Prest-O-Sales and Service, Inc., 102 Hunter avenue, Long Island City, N. Y., as distributor for USL welding equipment and accessories in the metropolitan district.

E. W. Page, research engineer of the General Electric X-Ray Corporation, Chicago, read a paper on the application of X-rays to non-destructive testing and process control in the metal industries at a meeting of six New England chapters of the American Society for Steel Treating, which was held at Hartford, Conn., on April 14.

The welding department of the Coleman Electrical School, Kansas City, Mo., has just issued a new sixteen-page catalog covering the courses given by the school in welding, brazing and cutting. The booklet is profusely illustrated and lays particular emphasis on the new fields for welding which are creating jobs for trained operators.

Armco Metalcurb, one of the newest products of the American Rolling Mill Company, Middletown, Ohio, is a product designed to reduce road construction and maintenance costs. It consists of a pair of smooth metal curbs connected at frequent intervals by tie-rods, gauged for the width of the finished pavement. A well illustrated bulletin has just been issued which gives full details.

Roberts Welding Equipment Co., 153 Seventh street, San Francisco, Cal., is being made a division of the Herbert Moore Machinery Co. The newly organized concern will be called the Roberts-Moore Company. It will be located at 140 First street, San Francisco, and will handle Westinghouse arc welding equipment in that city and in northern California.

The California Corrugated Tank Co., of West Berkeley, Cal., has purchased the Spokane Culvert and Tank business (Spokane, Wash.) Charles A. Mowry, president and principal owner of the Spokane company, also announced that with the Spokane company goes the Pure Iron Culvert & Manufacturing Co., of Portland, Ore.

A full evening's program devoted to welding was held in the State Trade School, Hartford, Conn., on March 10th. Members of the Hartford Engineers' Club and of the local chapter of the A. S. M. E., were invited. Talks on welding were given by J. D. Tierney, of the Storts Welding Company, Meriden, Conn., and Mr. M. W. Brewster, of the General Electric Company. The subjects discussed included Structural Steel Work, Fabricated Steel for Machinery Construction, Electric Brazing and Atomic Hydrogen Welding. A number of actual demonstrations were given which were first explained by Mr. Tierney. Further interest was added to the program by the showing of talking-moving pictures on the atomic hydrogen process.

The Claud S. Gordon Company, who recently installed a new commercial X-ray laboratory at 2416 West 15th Place, Chicago, Ill., announce the appointment of Wm. G. Praed as radiograph engineer in charge of this laboratory.

The Welding Equipment & Supply Corp., 1349 Milwaukee, East Detroit, Mich., has recently been appointed a distributor for the line of spot welders manufactured by the Lenney Machine & Manufacturing Co., Warren, Ohio.

In a bulletin on "Vocational Rehabilitation for the Physically Disabled in Ohio," published by the Ohio Department of Education, are several photographs of former students of the Cleveland School of Welding, who have learned how to make a living at the welding trade in spite of physical limitations due to industrial accidents.

The Torrance Welding & Machine Co., of Torrance, Cal., reports an additional member to their company. A one-third interest in the business has been sold to E. E. ("Slim") Hampton. The company features general oil field welding and is operating under a lease from the California Oil Tool Co.

H. C. (Jack) Barrington recently opened a welding shop at 436 Narbonne, Lomita, Cal. Mr. Barrington was for the past seven years, until a few months ago, associated with the Field Shop Department of the Union Tool Co., of Torrance. General welding and machine work will be featured in the new shop, with special attention to hard-facing work of all kinds.

Al Joslin, who operates a welding shop at 1057 W. Manchester avenue, in Los Angeles, Cal., announces plans for moving into new quarters in the near future. The new location will be directly east of his present shop and will be a new building 50 ft. wide by 60 ft. in length. Additional equipment will be installed in the extra space provided by the new building, and the expansion program will also include the additional feature of ornamental iron work in the new plant.

F. W. Shrader, of the Shrader Electric Co., Inc., Los Angeles, Cal., manufacturers of electric arc welders, recently returned from an extended trip of about ninety days in the oil fields of the Mid-Continent. While in Tulsa, Okla., Mr. Shrader placed the agency for their electric welders with the Tractor-Truck Equipment Co., jobbers, who will handle the line in that district.

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

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For Sale—Complete Torchweld N F welding outfit with regulators, hose, etc. $100.00 value for $50.00. Address Box 408, The Welding Engineer.

For Sale—200 Amp. transformer type welder complete with standard accessories, for use on 220 volt 60 cycle A. C. power supply. Price reasonable. Excellent for job shop welding. Box 409, The Welding Engineer.

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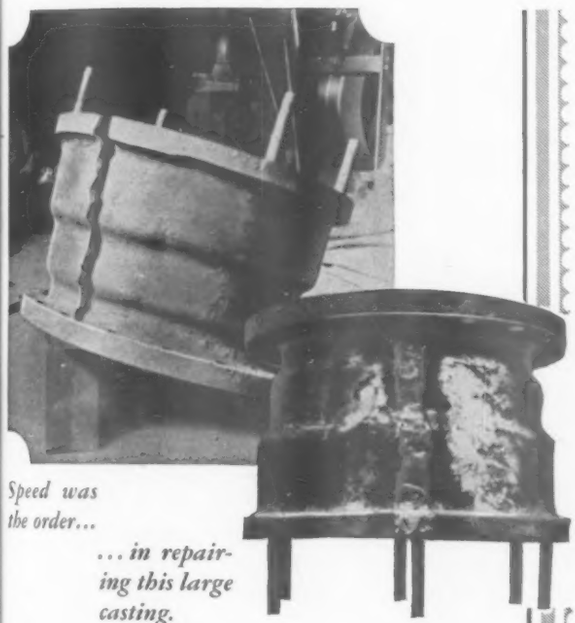

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Manganese Bronze	1598°F
Brazing Metal	1634°F
Naval Bronze	1625°F
Electrolytic Copper	1981°F
Silicon Copper	1981°F
Phosphor Bronze	1922°F
Everdur*	1866°F
for arc welding	
Silicon Copper	1981°F
Phosphor Bronze	1922°F
Everdur*	1866°F

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OFF Fort William, Ontario, a lake vessel was laid up with a disabled engine. Prompt action was necessary. Tobin Bronze was the logical choice for this emergency. After chipping out the crack of the broken casting, the weld was completed without pre-heating in less than an hour...and the vessel moved out the same day.

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Publication B-13, containing detailed information on all Anaconda Copper Alloy Welding Rods, mailed free at your request.

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CONTRACTS WANTED

Job Wanted—For a new dual drive Westinghouse Flex-Arc welder with road trailer mounting. Will rent or work on contract and furnish skilled operator. Address Box 410, The Welding Engineer.

Welding Specialist—In laying and welding all kinds of pipe lines. Contracts for other welding work also taken. Let me give you an estimate. Wm. Engling, 1077 Hegeman St., Schenectady, N. Y.

WANTED TO BUY

Wanted—Back copies of Acetylene Journal, issues of September and December, 1926, and February, 1928. Anyone who has these copies for disposal please communicate with The Welding Engineer.

POSITIONS WANTED

Acetylene Welder—Wants job on pipe line or in general job shop. Three years' experience with all kinds of gas work. Address Elmer Sievert, R. R. 4, Seymour, Wis.

Combination Welder—Five years' experience, both gas and electric. Married. Will go any place. Desire permanent position. Address F. V. Mathis, 11842 Wallace St. at Roseland Sta., Chicago, Ill.

Combination Welder—Experienced, desires position with going concern. Have demonstrated and sold equipment. Best references and years of experience. Box 412, The Welding Engineer.

Young Welder—Experience both gas and electric in boiler, job shop and pipe welding. Desire permanent job. Go any place. Address Carl H. Johnson, 710 Avenue C, Dodge City, Kansas.

Sales Promoter—With twelve years' experience in placing jobbers and training salesmen. Would like to connect with manufacturer. Can start at once. Box 413, The Welding Engineer.

Welding Expert—Well acquainted with all kinds of practical welding construction, laboratory work and selling. Desire connection with company in developing new equipment for oxy-acetylene and arc welding. Box 414, The Welding Engineer.

Combination Welder—14 years' experience, pressure vessel, light and heavy plate, pipe and refrigerator. Married. Go any place. Desire permanent position. Joe Mazur, 2909 S. Throop St., Chicago, Ill.

Combination Welder—11 years' experience on boilers, pipe line and structural steel. Married. Go any place. Best references. Box 415, The Welding Engineer.

Position Wanted—Practical and experienced oxy-acetylene equipment salesman desires position with factory. Well acquainted with industrial and shop trade in Texas and Oklahoma. Box 416, The Welding Engineer.

Electric Welder—Desires permanent position. Eleven years' experience on all classes of arc welding. H. B. Furman, Box 466, Matamoras, Pa.

Position Wanted—Five and one-half years' experience on pipe lines, high and low pressure welding. Will go any place. Good references. Clarence Joy, 912 Pleasant St., St. Joseph, Mich.

Combination Welder—26 years old, 8 years' experience in contract shop. Would like steady position with small firm or building contractor. C. W. Lee, Amory Mch. Shop, Amory, Miss.

Position Wanted—Acetylene welder and blacksmith—13 years experience in general welding and blacksmithing. Petrie, care of Grand Rapids Welding Supply Co., Grand Rapids, Mich.

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